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# Research and Development Technical Report ECOM-4106

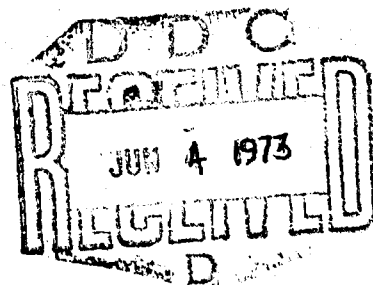
## UHF PROPAGATION PATH LOSS MEASUREMENTS AT LOW GRAZING ANGLES

Henry Schlusser

April 1973

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TECHNICAL REPORT ECOM-4106

UHF PROPAGATION PATH LOSS MEASUREMENTS AT LOW GRAZING ANGLES

by

Henry Schlusser

AIR TRAFFIC MANAGEMENT SYSTEMS TECHNICAL AREA  
AVIONICS LABORATORY

AMC Code No. 591 700.A1.072.26.01.R910Z-2

April 1973

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U. S. ARMY ELECTRONICS COMMAND, FORT MONMOUTH, NEW JERSEY



### ABSTRACT

This report covers RF path loss measurements near Fort Monmouth, N.J., over distances of up to 10 miles and at low grazing angles. Four frequencies were used during these tests, three in the UHF region and one just below it. Measurements were made with antennas vertically, horizontally, and circularly polarized. Paths were varied from non-line-of-sight to definitely line-of-sight. Comparison of losses under varying conditions were made and graphs for estimating losses in the area covered by these tests are included.

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## 1. BACKGROUND

The Avionics Laboratory of the U. S. Army Electronics Command is investigating the feasibility and the technology necessary for applying time ordered techniques to multifunction avionics and ground equipment for tactical use. As presently envisioned, the RF frequencies in such a system will be in the high end of the VHF band or in the UHF band. Much of the transmission in such a system would be at very low grazing angles where the transmission path can vary from line-of-sight to non-line-of-sight. If line-of-sight does not exist, the RF signal is subjected to many factors which degrade it. Even if line-of-sight exists, multipath can cause signal distortion and variation. In order to obtain meaningful data concerning the propagation losses which will be encountered in such a system, a series of experiments were conducted to determine the extent of the signal losses when transmitting in an environment typical of the anticipated multifunction system, namely low grazing angles and natural and man-made obstructions.

## 2. INTRODUCTION AND OBJECTIVE

This report describes a series of propagation path loss tests to measure path losses at low grazing angles in the 225 to 2,300 MHz range. Path loss is the signal attenuation expressed as the ratio of the received power to the transmitted power. It can be expressed as a number, but is usually expressed as transmission loss in dB. The path loss is dependent on such factors as --

- a. the distance between the transmitter and receiver;
- b. the carrier frequency;
- c. the signal absorption factors due to the environment;
- d. the multipathing contributions which can either reinforce or reduce the received signal;
- e. diffraction losses in paths which are marginally line of sight, and;
- f. depolarization.

To be useable, the amplitude of the received signal must be large enough to provide an adequate margin over competing signal interference and noise. In general, the transmitted power required varies with the square of the distance between the transmitter and the receiver and also as the square of the ratio of the carrier frequencies.

The tests described in this report were conducted specifically to obtain input data for the Micro Navigation and Position Locating System (MNPLS). Since MNPLS has to be effective in any azimuth, the allowable means for increasing both the transmitting and receiving antenna gains are restricted to those procedures which entail vertical stacking. Such vertically stacked arrays concentrate the RF energy into a narrower vertical angle, thereby increasing the gain in the horizontal direction and decreasing the vertical coverage. The effects of the propagation path, however, can only be known in general, but not in detail, since the effects of the terrain, buildings, and

foliage that account for multipathing, signal absorption and scattering, diffraction, and depolarization cannot be determined exactly or easily separated. Even though these effects usually cannot be isolated from each other, an accumulated record of path losses can provide a practical range of path losses for which an operable system has to compensate. The tests described in this report were conducted to measure these effects in order to establish some guidelines for future systems design.

### 3. TEST PROCEDURE

All tests covered by this report were conducted between the Hexagon Building at Fort Monmouth and remote sites. The receiving antenna was always located on the roof of the Hexagon. The transmitter was located at various remote sites within a radius of less than 10 miles from the receiving site. All equipment, antennas, and cables were carefully calibrated for gain or attenuation so that the path loss could be accurately calculated from the transmitted and received power. At the transmitter site, the frequency and power output were continuously monitored and recorded. At the receiving site, received signal strength and transmitting antenna height were recorded on a strip chart recorder. Meteorological data and other pertinent data were recorded. Sample antenna and cable data, meteorological data, and a test schedule are shown in Tables I, II, and III. Figure 1 is a map of the area showing the receiving site and the various transmitting sites.

Three types of antenna supports were used at the transmitting sites. At site 19B, there was a permanent 85-foot high tower with a track on its side on which an antenna could be run up and down. At Monmouth Country Airport, site 5, a semipermanently installed crank-up tower was used, the maximum height of which was 88 feet. The third support was a portable crank-up mast with a maximum height of 33 feet. This crank-up mast could be set up at any of the sites.

The transmitter and all other equipments required at the transmitter site were contained in a truck-mounted shelter. The truck was driven to the various transmitting sites and the RF transmitter was connected either to the permanently emplaced antenna system at a particular site or to a portable one. Tests were conducted with various types of antennas and various polarizations.

A typical test run consisted of elevating the antenna from the lowest height obtainable with the mast being used, up to the highest possible height and then lowering it again. In some of the tests, the maximum height had to be limited due to high winds. During this elevation cycle the transmitter was kept at constant power and the received signal strength was recorded as a function of transmitting antenna height. Sample recording taken at the receiver is shown in Figure 2. Table IV shows a typical data reduction table. The values of received signal strength are read off the strip chart and tabulated with accompanying transmitting antenna heights. These values are then algebraically combined with transmitted power, antenna gains, and cable losses to arrive at the path loss (para 7). Most test runs were repeated two or three times, and the final tabulated path loss value was, at each height, an average of the individual path loss values. This average value was then plotted, as shown on the sample plot in Figure 3.

Table I. Antenna and Cable Data

FREQUENCY: 229.5 MHz

ANTENNA		CABLE		
TYPE	GAIN dB	TYPE	LENGTH FT.	LOSS dB
AT-197	1.2	FHJ4-50	100	1.4
			130	1.8
T-29	8.0	RG-319A/U	100	0.32
			130	0.42
EMCO 3101	- 3.8	RG-58C/U	100	9.0
			100	2.0
		FSJ4	150	3.0

FREQUENCY: 371.4 MHz

AT-197	2.0	FHJ4-50	100	1.8
			130	2.3
T-29	8.0	RG-319A/U	100	0.4
			130	0.52
EMCO 3101	6.1	RG-58C/U	100	13.0
			100	2.6
		FSJ4	150	3.9

FREQUENCY: 1545 MHz

AEL Horn	14.4	FHJ4-50	100	4.4
			130	5.7
Andrew Disccone	2.5	RG-319A/U	100	0.9
			130	1.2
Andrew Biconical	0.3	RG-58C/U	100	29.0
			100	6.5
EMCO 3102	- 0.4	FSJ4	150	9.75

FREQUENCY: 2290 MHz

AEL Horn	16.6	FHJ4-50	100	5.2
			130	6.8
Andrew Disccone	1.3	RG-319A/U	100	1.3
			130	1.6
Andrew Biconical	0.7	RG-58C/U	100	36.0
			100	8.5
		FSJ4	150	12.75

FHJ4-50  
RG-319A/U } Mollax

FSJ4 Superflex

Table II. Meteorological Data

RUN	DATE	TIME	ATMOS. PRESS. (IN.)	TEMP. (°C)	DEW PT. (°C)	REL HUMID. (%)	WIND		REMARKS
							DIR. (DEC)	SP. & GUST (KTS)	
72/01/24.03	1/24/72	0914	30.02	+ 9	+ 1	-	000	5 G10	MCA Site #5
		0959	30.06	+ 8	+ 1	72	330	2-4G7	
		1043	30.09	+11	+ 1	66	270	2-6G10	
		1248	30.06	+12	+ 1	57	000	1-4	
		1455	30.09	+12	- 2	56	000	0-0	
		1612	30.09	+ 9	- 1	60	050	1-7	
72/01/25.01	1/25/72	0837	29.75	12	10	94	270	5 G20	MCA Site #5 0857 Light Rain Falling At This Time
		1045	29.82	10	0	54	000	10 G25	
		1207	29.82	11	- 2	51	270	10 G25	
		1247	29.84	10	-10	32	270	15 G25	
		1450	29.94	8.5	-15	26	270	15 G25	
		1557	30.01	6	-15	31	270	15 G25	
72/01/26.01	1/26/72	0943	30.49	- 5	-20	60	270	2-4 G10	MCA Site #5
		1100	30.49	- 4	-16	74	270	2-4 G8	
		1250	30.42	- 2	-18	88	250	2-4 G8	
		1412	30.40	+ 1	-18	-	250	2-4 G8	
		1619	30.49	+ 1	-17	-	250	5-6 G12	
		0905	30.44	- 5	-25	-	270	2-3	
72/01/27.01 Thru 72/01/27/06	1/27/72	1053	30.44	- 4	-21	62	-	-	MCA Site #5
		1315	30.36	- 3	-21	66	270	2-3	
		1434	30.36	- 1	-19	77	270	2-4 G8	
		1535	30.36	- 3	-19	-	270	2-3 G6	
		1605	30.35	- 3	-19	-	270	2-3 G6	



Table III. Test Schedule

Date	Frequency (MHz)	Site	No. of Runs	Transmitting Antenna
24 Jan 72	1545	MCA 5	3	AEL Horn
25 Jan 72	1545	MCA 5	1	AEL Horn
27 Jan 72	1545	MCA 5	4	AEL Horn
27 Jan 72	371.4	MCA 5	2	AT-197
28 Jan 72	229.5	MCA 5	1	AT-197
28 Jan 72	371.4	MCA 5	1	AT-197
28 Jan 72	1545	MCA 5	1	AEL Horn
31 Jan 72	1545	Highlands 21	3	AEL Horn
31 Jan 72	1545	Highlands 21	2	Andrews Discone
1 Feb 72	371.4	Highlands 21	3	AT-197
1 Feb 72	229.5	Highlands 21	2	AT-197
1 Feb 72	1545	Highlands 21	1	AEL Horn
1 Feb 72	2290	Highlands 21	2	AEL Horn
7 Feb 72	229.5	Wayside 19	2	AT-197
7 Feb 72	371.4	Wayside 19	2	AT-197
7 Feb 72	1545	Wayside 19	3	Andrews Discone
8 Feb 72	1545	Wayside 19	2	AEL Horn
8 Feb 72	1545	Wayside 19	2	Andrews Discone
8 Feb 72	1545	Wayside 19B	3	AEL Horn
9 Feb 72	371.4	Wayside 19B	2	AT-197
9 Feb 72	1545	Wayside 19B	2	AEL Horn
9 Feb 72	1545	Wayside 19B	3	AEL Horn (Horiz. Pol.)
14 Feb 72	371.4	Wayside 19B	3	T-29 (Vert. Pol.)
14 Feb 72	371.4	Wayside 19B	2	T-29 (Horiz. Pol.)
14 Feb 72	229.5	Wayside 19B	2	T-29 (Vert. Pol.)
14 Feb 72	229.5	Wayside 19B	2	T-29 (Horiz. Pol.)
16 Feb 72	371.4	Wayside 19B	2	Emco 3101 (Circular P.)
16 Feb 72	229.5	Wayside 19B	3	Emco 3101 (Circular P.)
16 Feb 72	1545	Wayside 19B	3	Emco 3102 (Circular P.)
17 Feb 72	1545	Wayside 9	3	AEL Horn
17 Feb 72	1545	Wayside 9	2	Andrews Discone
18 Feb 72	1545	Wayside 9	2	AEL Horn
18 Feb 72	1545	Wayside 9	2	Andrews Discone
18 Feb 72	371.4	Wayside 9	2	AT-197
18 Feb 72	229.5	Wayside 9	3	AT-197
10 Mar 72	371.4	Wayside 19	4	AT-197
10 Mar 72	371.4	Wayside 19B	2	AT-197
10 Mar 72	371.4	Wayside 19B	2	Emco-3101 (Circ. Pol.)
10 Mar 72	229.5	Wayside 19B	2	Emco-3101 (Circ. Pol.)
10 Mar 72	229.5	Wayside 19B	1	T-29 (Vert. Pol.)
10 Mar 72	229.5	Wayside 19B	1	T-29 (Horiz. Pol.)
10 Mar 72	371.4	Wayside 19B	1	T-29 (Horiz. Pol.)
10 Mar 72	371.4	Wayside 19B	1	T-29 (Vert. Pol.)
13 Mar 72	1545	Wayside 19	2	AEL Horn
13 Mar 72	1545	Wayside 19	2	Andrews Discone
13 Mar 72	1545	Wayside 19B	2	AEL Horn
13 Mar 72	1545	Wayside 19B	2	AEL Horn (Horiz. Pol.)
13 Mar 72	1545	Wayside 19B	1	Emco-3102 (Circ. Pol.)
14 Mar 72	371.4	Wayside 9	2	AT-197
14 Mar 72	229.5	Wayside 9	2	AT-197
14 Mar 72	1545	Wayside 9	2	Andrews Discone
14 Mar 72	1545	Wayside 9	2	AEL Horn

Table IV. Test Data Sheet

OPER. FREQ.		1545 MHz		DATE: 9 FEBRUARY 72		TEST DATA SHEET		REC. SITE ANT. HT. FT.		START: 1325 HRS	
SITE		LOCATION		TYPE ANTENNA		ANT. GAIN (dB)		CAUSE LOSSES (dB)		EQUIV. SYS. PWR. (ESP)	
TRANSMITTER		WAYSIDE 19B		HORN		14.4		5.7		XMT. PWR. 44	
RECEIVER		ECOM HEX.		BIOGICAL		0.3		1.2		+ANT. GAINS 14.7	
TOTAL ANT. GAIN (XMT + REC.)		14.4 + 0.3 = 14.7 dB								-CABLE LOSSES 6.9	
TOTAL CABLE LOSS (XMT + REC.)		5.7 + 1.2 = 6.9 dB								=ESP = 51.8 USE 52	
XMT. SITE HEIGHT ABOVE SEA LEVEL		140 FT.		RCV. ANT. HEIGHT ABOVE SEA LEVEL		140 FT.					
XMT. SITE		TEST		TEST		TEST		TEST		REMARKS	
ABN. GNS. HT		720209-01		720209-01		720209-01		720209-02			
8	97	88	149	140	149.5	2					
10	96	92	148	144	146.0	2					
15	82	82	134	134	134.0	2					
20	85	83	137	135	136.0	2					
25	80	80	132	132	132.0	2					
30	81	81	133	133	133.0	2					
35	81	81	133	133	133.0	2					
40	76	75	128	127	127.5	2					
45	72	70	124	122	123.0	2					
50	68	68	120	120	120.0	2					
55	65	65	117	117	117.0	2					
60	—	62	—	114	114.0	1					
65	—	60	—	112	112.0	1					
END 720209-01 - 1355											
START 720209-02 - 1350											
END 720209-02 - 1400											
MEAN READING OF CHART RECORDINGS											



Figure 1. Map of the Test Area

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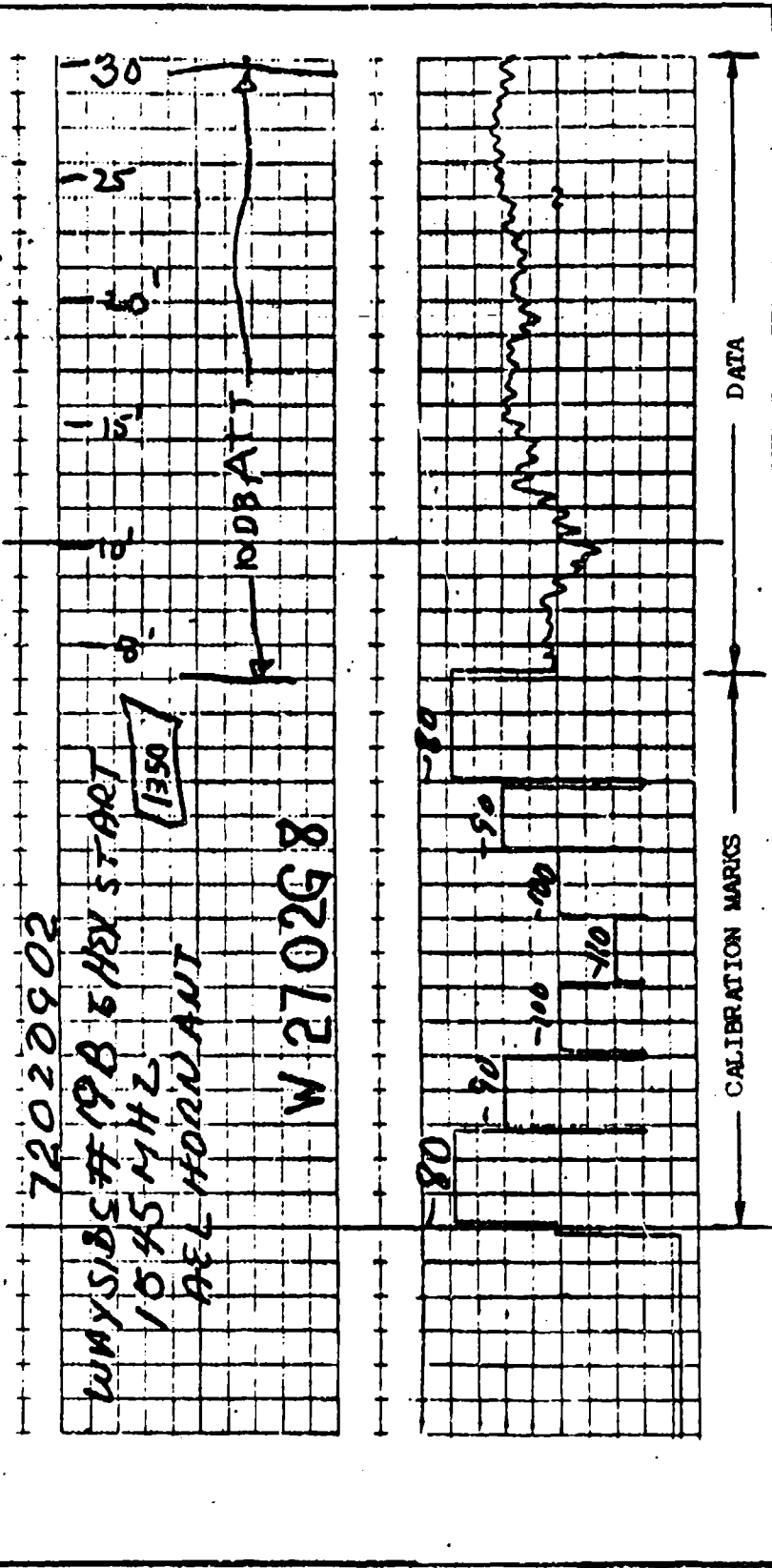
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PROPAGATION PATH LOSS

DATE: 9 FEBRUARY 72 TEST RUN S/N: 420209-02

PATH: WAYSIDE SITE No. 19B TO ECOM HEXAGON

OPER. FREQ.: 1545 MHz



**Figure 2. Sample Received Signal Recording**

PROPAGATION PATH LOSS  
DATE: 9 FEBRUARY 72 TEST RUN SIN: 720209-01-02  
PATH: WAYSIDE SITE No. 19B TO ECOM HEXAGON

OPER. FREQ.: 1545 MHz

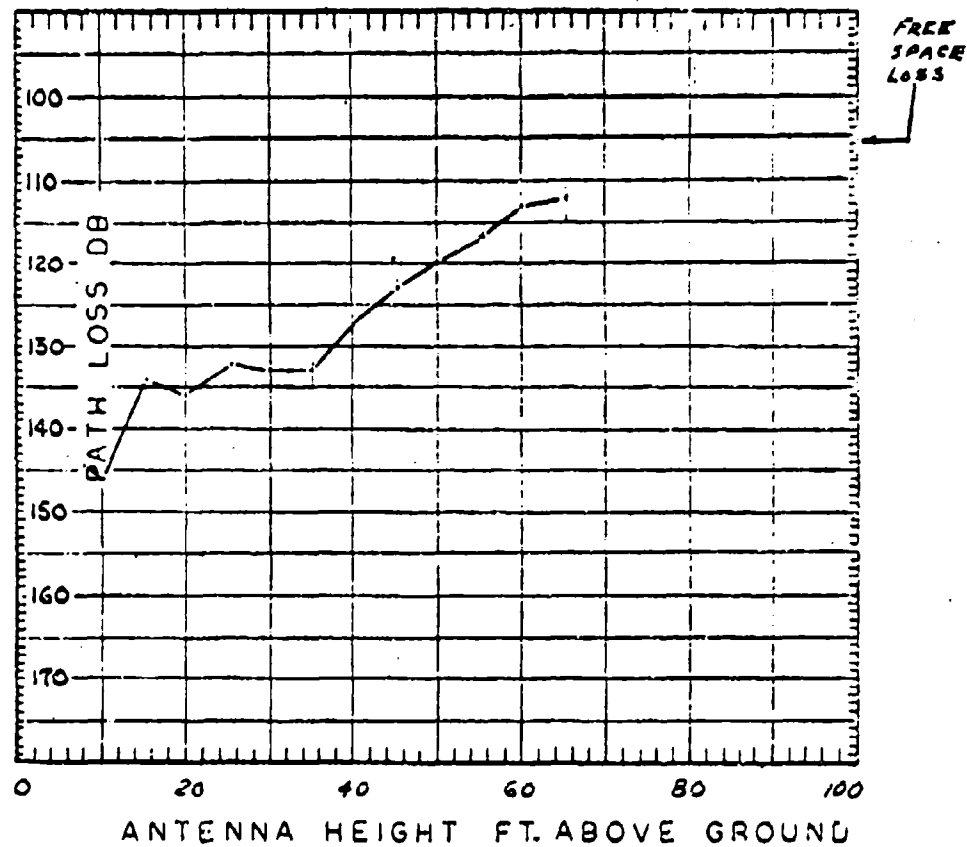


Figure 3. Sample Propagation Path Loss Graph

#### 4. RECEIVING EQUIPMENT

An Airborne Instruments Laboratory (AIL) Model 707 Spectrum Analyzer was used as the receiver for these tests. The output of this analyzer is a dc voltage proportional (in dB) to the input signal strength. The receiving antenna was connected to the spectrum analyzer through a low loss cable for tests at the lower frequencies, and through a low loss cable and a 20-dB preamplifier at the higher frequencies. The output of the spectrum analyzer was recorded on a strip chart recorder and pertinent data was annotated on the strip chart.

An accurately calibrated source of RF was used to calibrate the receiving setup. This RF source was substituted for the antenna during the calibration procedure. All other connections were unchanged (Figure 4). In this manner, the entire receiver setup was calibrated since the signal from the calibrating source passed through the identical path as the received signal from the antenna. To calibrate a strip chart, several calibrated levels of RF were fed into the receiving setup and recorded on the strip chart. On the strip chart, each level was marked with its corresponding signal level which was then used as the standard in reducing the data (Figure 2).

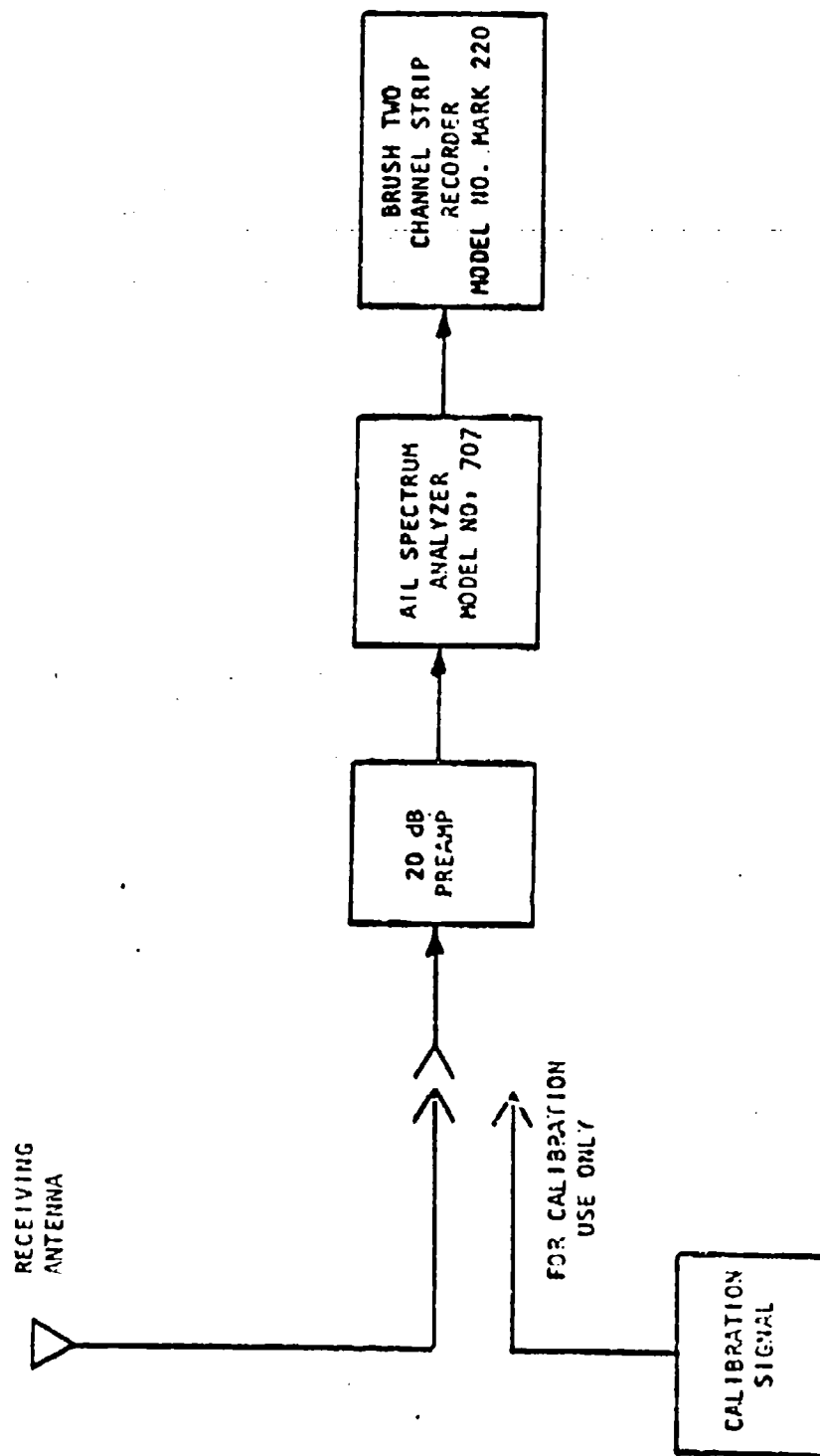
#### 5. TRANSMITTING EQUIPMENT

The transmitter and the RF power and frequency monitoring equipment were installed in an S-280 shelter which was mounted on a M-35 military truck (Figure 5). The transmitter power oscillator was a MICRODOT Model 445. This power oscillator, when used in conjunction with several plug-in modules, provided a CW RF source continuously variable between 2 and 2,500 MHz, with a power output as high as 50 watts.

The RF power output from the transmitter was continuously monitored with a BIRD THRULINE Model 43 WATTMETER, which could also be used to measure reflected power to check for cable or antenna malfunctions. A SYSTRON DONNER Model 1037 Frequency Counter was used to monitor the RF frequency. The binary coded decimal (BCD) output from this frequency counter was fed to a HEWLETT PACKARD D/A CONVERTER Model R50562A, whose output was plotted on one channel of a BRUSH MARK 220 strip chart recorder. The output of the thruline wattmeter was recorded on the second channel of the strip chart recorder (Figure 6). Thus, there was a continuous record of transmitter power output and frequency.

#### 6. TRANSMITTING SITES

The mobile transmitter was located at many different sites for these tests. These sites included areas where permanent or semipermanent antennas were installed, as well as places where the portable antenna mast was used. This section contains brief descriptions of these sites, the physical environment in the vicinity of the antenna which could affect propagation, and terrain profiles for the sight line. The sight line is defined as an imaginary straight line from the transmitting antenna to the receiving antenna. The locations of most of the various transmitting sites are also shown on the map in Figure 1.



TYPICAL EQUIPMENT SETUP FOR  
MEASURING AND RECORDING RECEIVER SIGNAL

Figure 4. Receiver Recording Equipment

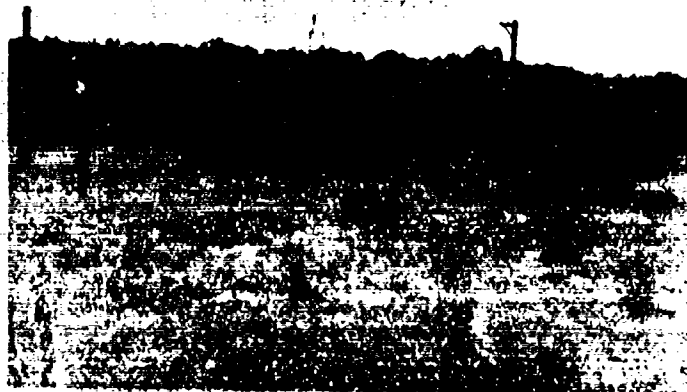
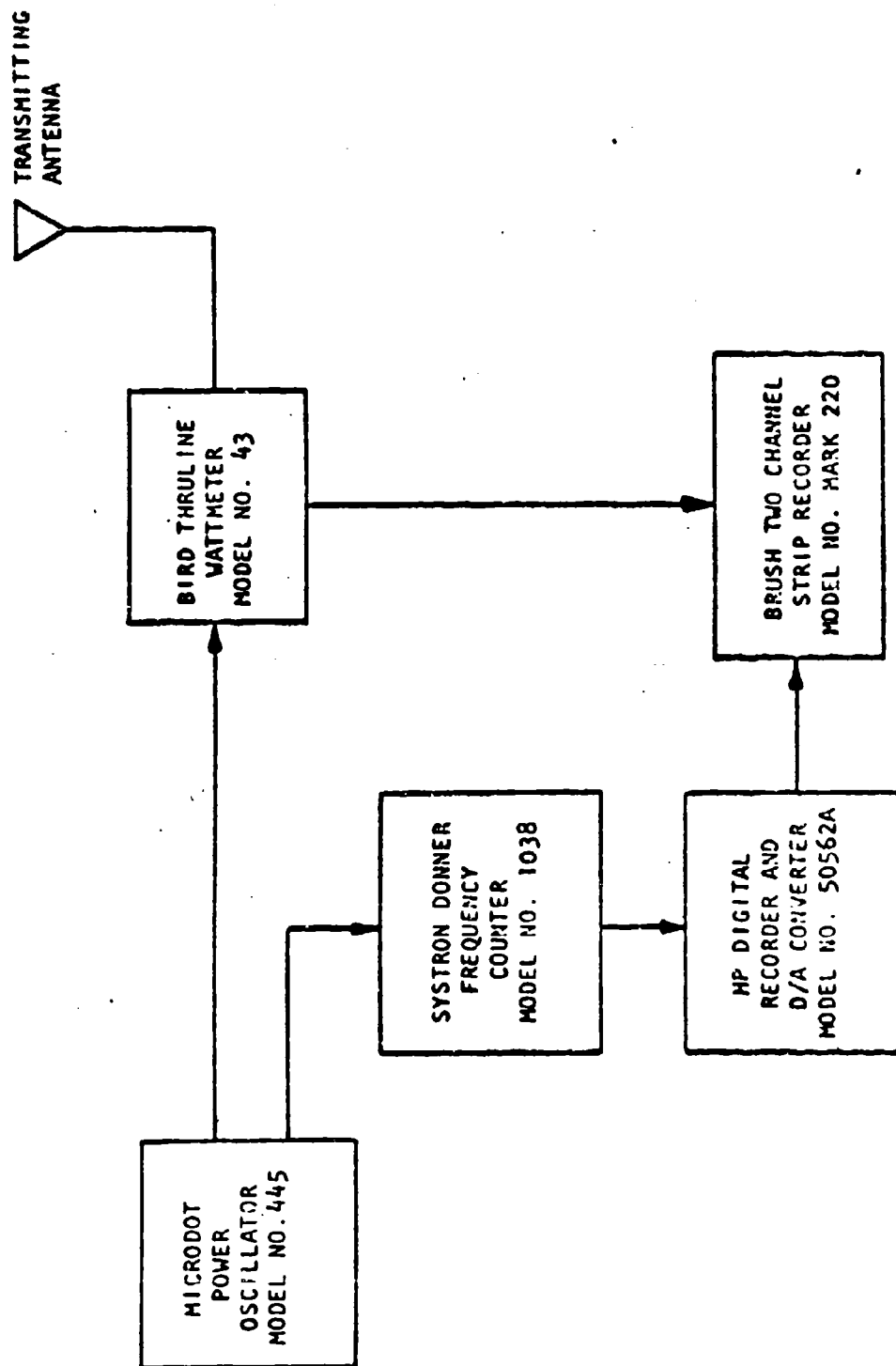


Figure 5. Transmitter Van





TYPICAL EQUIPMENT SETUP FOR  
MONITORING FREQUENCY AND POWER OUTPUT  
AT THE TRANSMITTER SITE

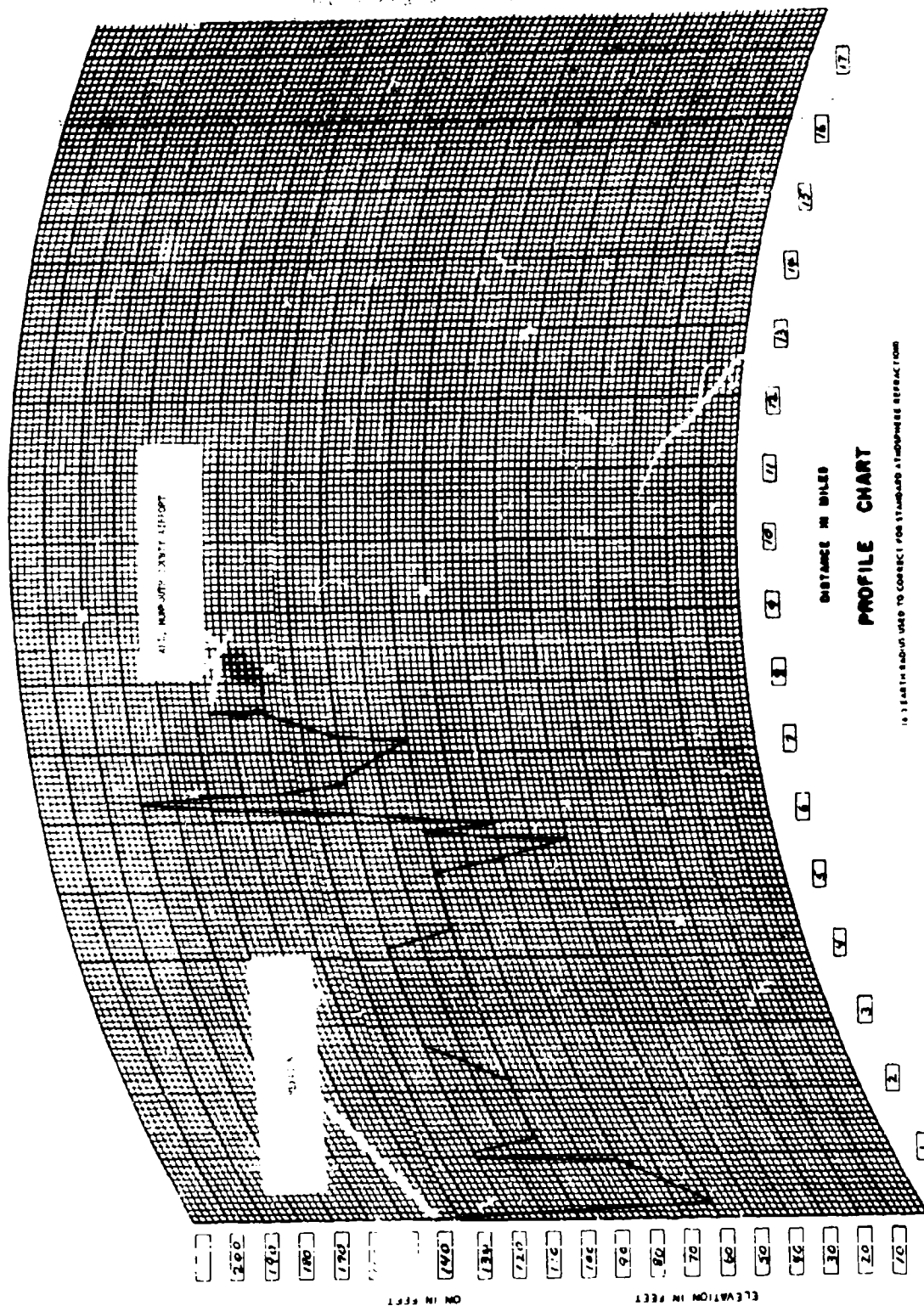
Figure 6. Transmitter Recording Equipment

a. AEL, Monmouth County Airport Site 5.

Site 5 (Figures 7 and 8) is located among 20-foot pine trees. The sight line is through this wooded area for 150 feet to a clear area, then 500 feet over a downward slope in the direction of the receiver location. To the right of the sight line, at 45 degrees, 130 feet away, there is a metal hanger the side of which runs +30 degrees relative to the sight line.



Figure 7. AEL, Monmouth County Airport Site 5



DA FORM 11-47 PREVIOUS EDITION OF THIS FORM IS OBSOLETE  
1 JUN 65

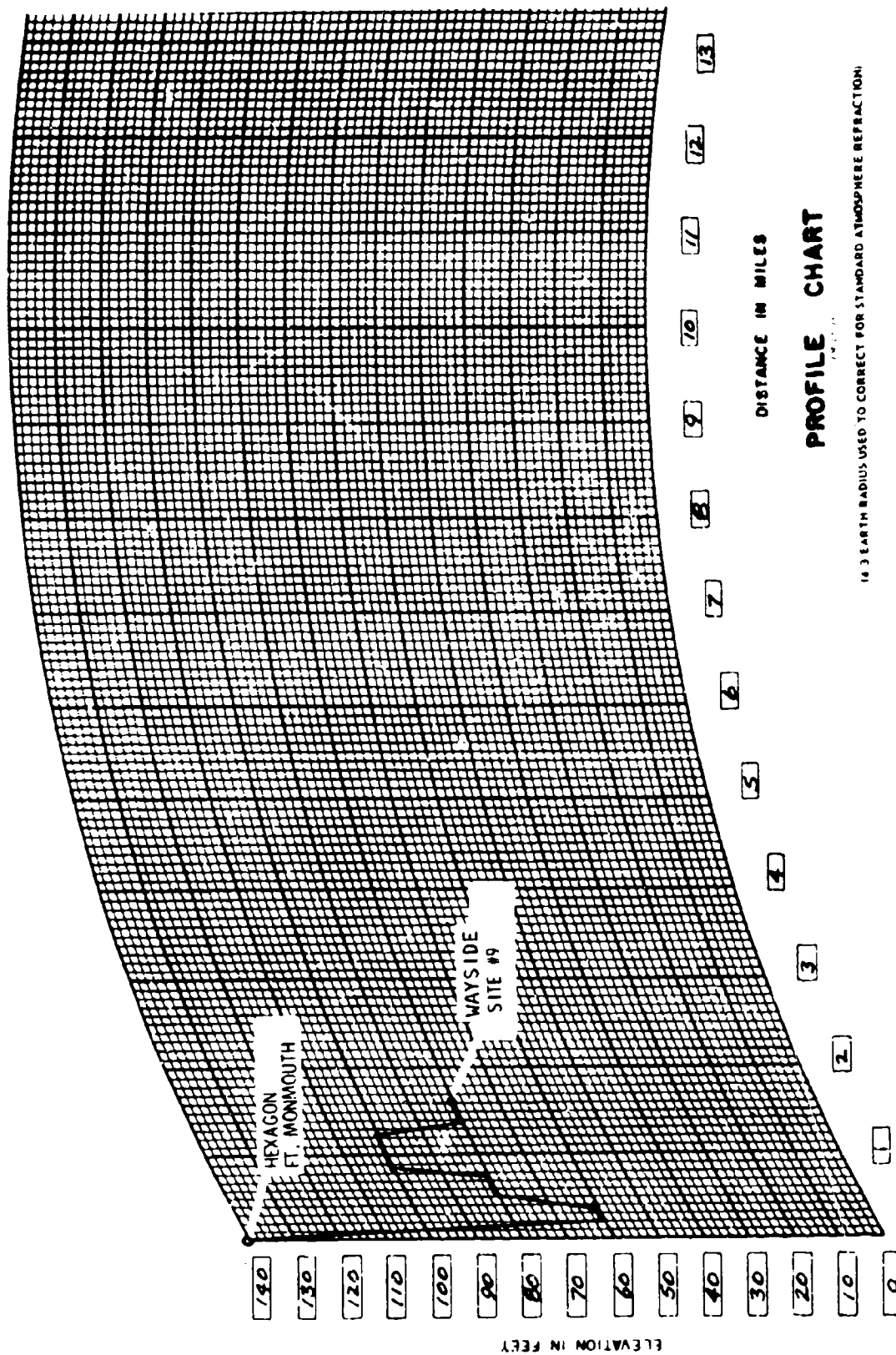
Figure 8. Site 5 Profile Chart

b. Wayside Site 9.

Site 9 (Figures 9 and 10) is located in a grass covered field. In line with the receiving site is a shallow 5-foot rise. A metal screen ventilator, 2 feet high by 3 feet in diameter is located 70 feet from the transmitter. Beyond the ventilator, at 150 feet, there is a pine tree 20 feet tall. Three-hundred feet away there are additional trees, 20 feet in height. To the left of the sight line at an angle of 15 degrees and a distance of 300 feet from the transmitter, there is a pole 40 feet tall with cables leading to three buildings beyond.



Figure 9. Wayside Site 9



14.3 EARTH RADIUS USED TO CORRECT FOR STANDARD ATMOSPHERE REFRACTION

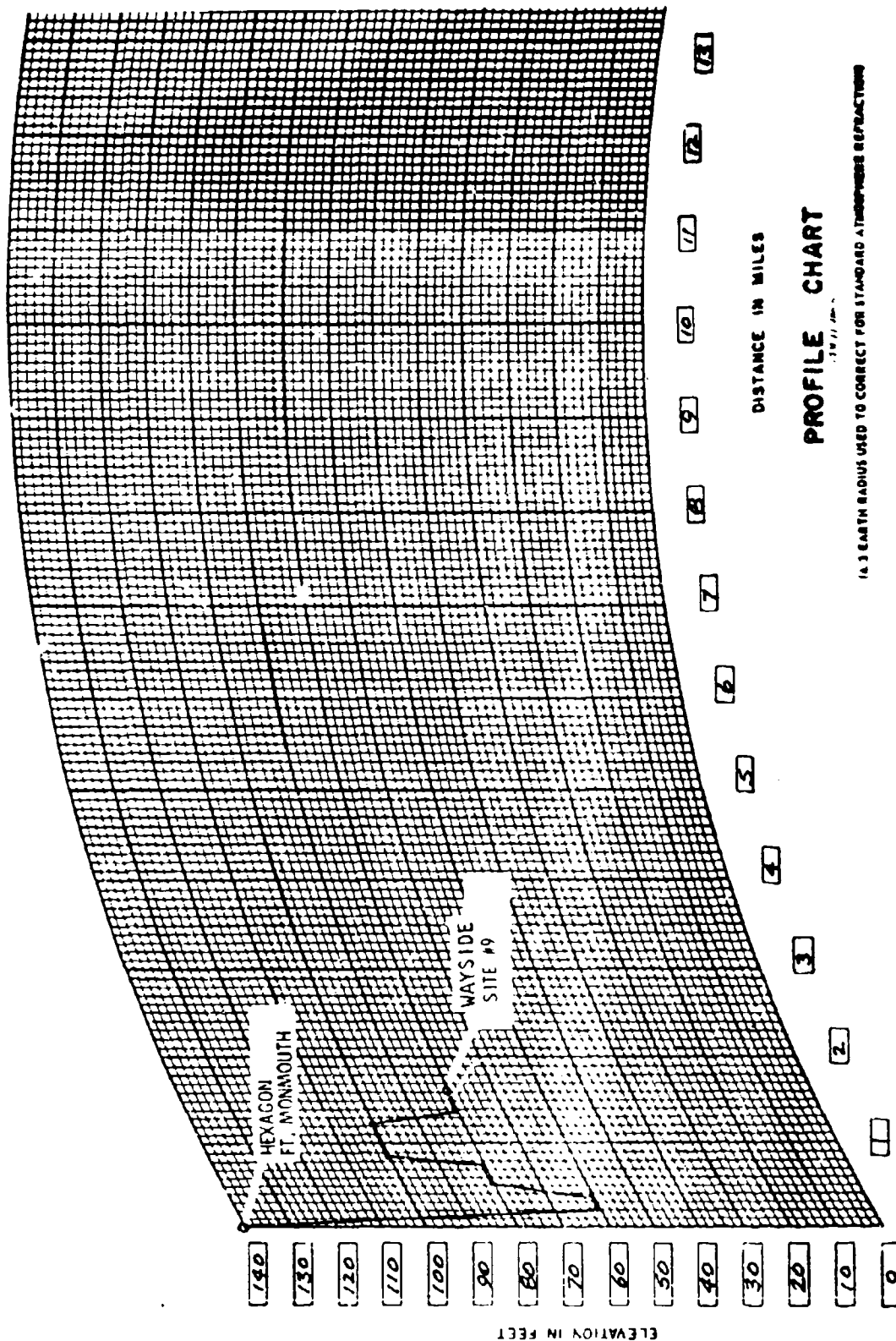
DA FORM 11-47 PREVIOUS EDITION OF THIS FORM IS OBSOLETE  
 JUL 65  
 Figure 10. Site 9 Profile Chart

c. Wayside Site 9A.

Site 9A (Figures 11 and 12) is located among 30-foot tall trees with approximately 6-inch diameter trunks. In line with the receiving site is a 130 foot stretch of wooded area, a dirt road, and 400 feet of gradually rising, grassy fields, bordered on the far side by trees 20 feet tall. At a distance of 300 feet from the transmitter, in line with the receiving site is a metal screen ventilator, 2 feet high, 3 feet in diameter. The terrain profile chart for this site is the same as for site 9 since it is located in the woods just a few feet from site 9.



Figure 11. Wayside Site 9A



DA FORM 11-47 PREVIOUS EDITION OF THIS FORM IS OBSOLETE  
1 JUL 65

Figure 12. Site 9A Profile Chart

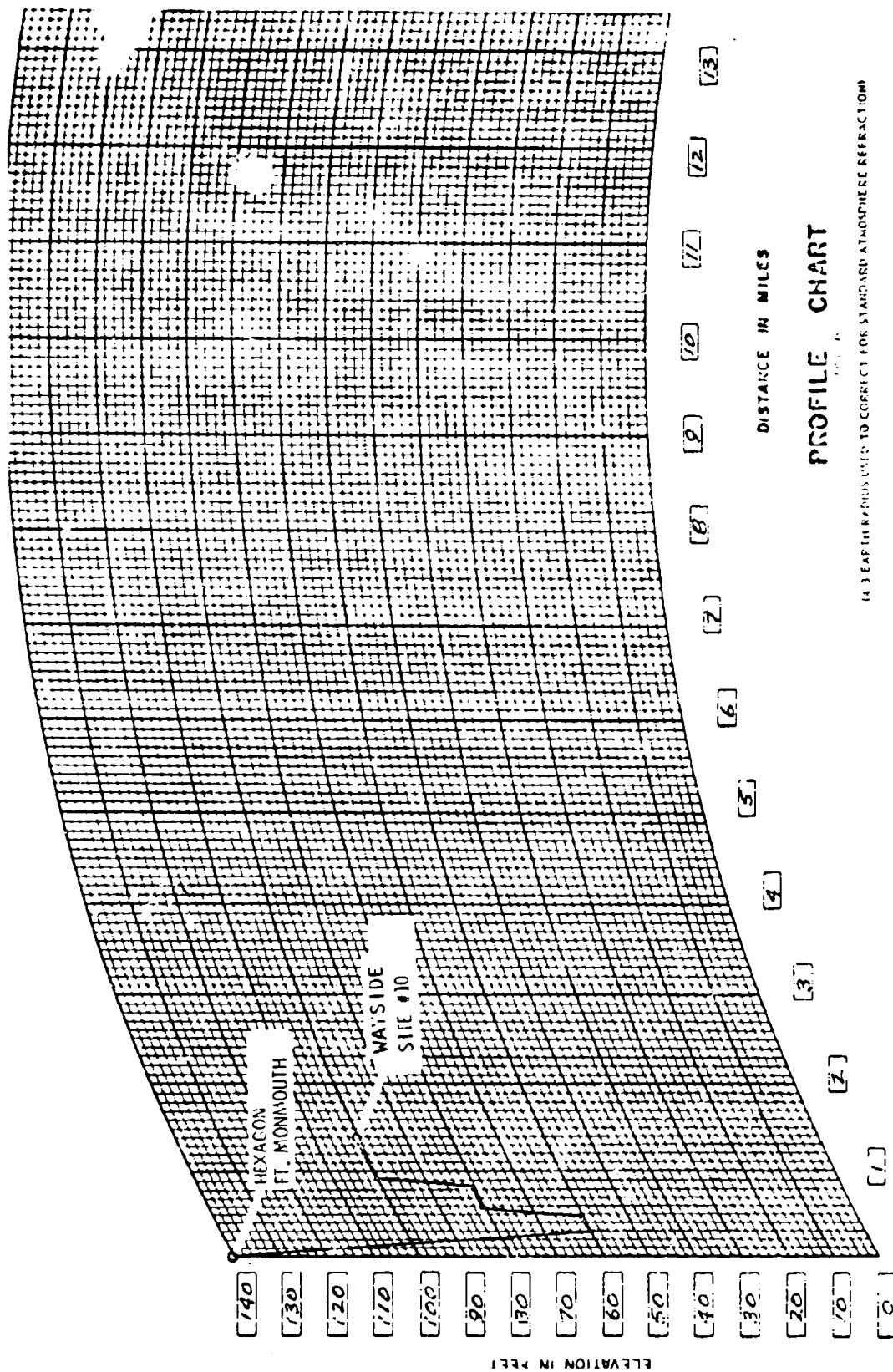
d. Wayside Site 10.

Site 10 (Figures 13 and 14) is located in a heavily weeded field. A guy wire crosses the sight line at a distance of 70 feet from the transmitter. There are two metal sheds, located 100 feet and 200 feet, respectively, from the transmitter. In addition, three wires 60 feet high cross the sight line 100 feet and again 275 feet from the transmitter. Three-hundred twenty-five feet from the transmitter, the sight line passes through a heavily wooded area.



Figure 13. Wayside Site 10





14.3 EAF IN RADII USED TO CORRECT FOR STANDARD ATMOSPHERE REFRACTION

DA FORM 11-47 PREVIOUS EDITION OF THIS FORM IS OBSOLETE

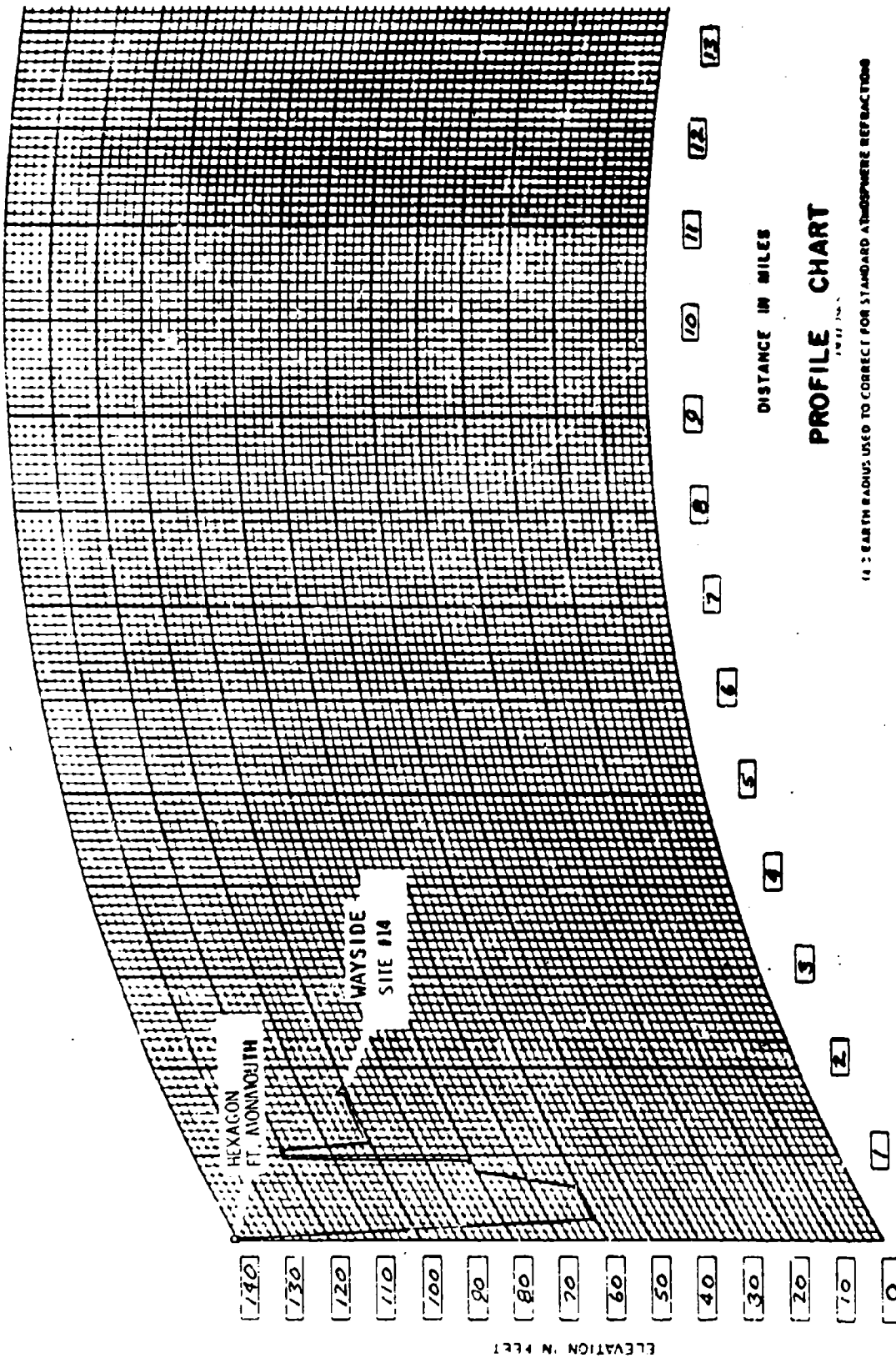
Figure 14. Site 10 Profile Chart

e. Wayside Site 14.

Site 14 (Figures 15 and 16) is located in the middle of a 15-foot wide stream which runs perpendicular to the sight line. There is an upward slope along the sight line rising to a level 15 feet above the transmitter site. The crest of this rise is 30 feet from the transmitter site. There are 15-foot trees on top of this rise. One-hundred feet from the transmitter are four 40-foot trees, then brush for 200 feet, and woods of 30-foot trees, all on a plane 15 feet above site 14.



Figure 15. Wayside Site 14



DA FORM 11-47 PREVIOUS EDITION OF THIS FORM IS OBSOLETE  
1 JUL 45

Figure 16. Site 14 Profile Chart

f. Wayside Site 19.

Site 19 (Figures 17 and 18) is located in a heavily weeded field. In line with the receiver site, 340 feet from the transmitter, is a large van beyond which there is a forest of trees 40-feet tall. One-half mile further along the sight line and perpendicular to it there are three large power cables suspended from metal towers 60 feet in height. Thirty feet to the left of the van is a second van, and at 40 and 60 feet, respectively, to the left of this van there are two 45-foot high towers. Thirty degrees to the right, and 100 feet away from the transmitter site 19, there are two metal huts, 15 feet high, 20 feet in diameter. Six hundred feet from the transmitter there is a ground plane, 300 feet in diameter with a 40-foot pole located at its center.



Figure 17. Wayside Site 19

# TERRAIN PROFILE - WAYSIDE 19 TO HEX

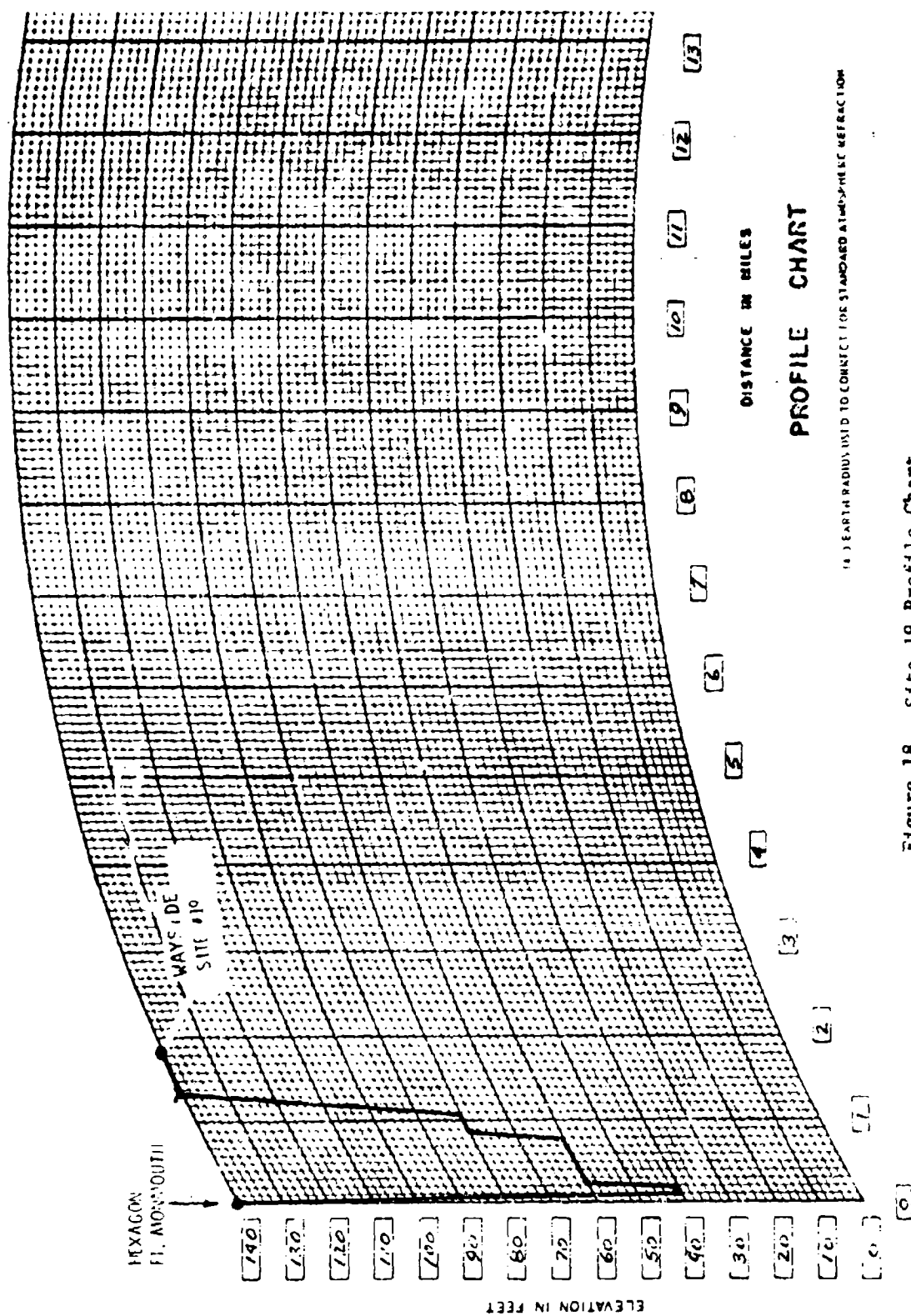


Figure 18. Site 19 Profile Chart

8. Wayside Site 19B.

Site 19B (Figure 19) is located atop an 85-foot tower which is 45 feet behind site 19 and 40 feet to the right, thereby placing site 19 obstacles 40 feet to the left of the receiver sight line. The receiver site is visible, through the power lines, which cross the sight line approximately 1.9 miles from the transmitter site.

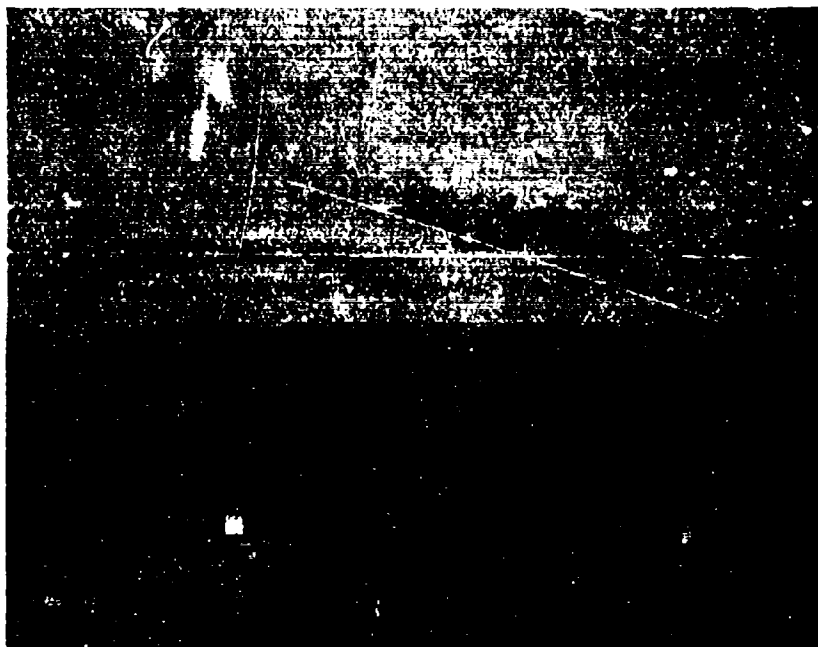


Figure 19. Wayside Site 19B

h. Evans Area "F" Site 20.

Transmitter site 20 (Figures 20 and 21) is located in a vine covered field. In line with the sight path are five 15-foot high cables and a row of trees 20 feet tall, running diagonally from 20 feet to the right of the transmitter site to a point 20 feet to the left of the sight line and 120 feet away from the transmitter site. There is a 40-foot high pole at that point. The aforementioned cables and line of trees cross the sight line 60 feet from the transmitter site. Along the sight line, 120 feet from the transmitter, is a road running approximately perpendicular to the sight line. There are 40-foot tall poles on both sides of this road. The poles support cables at the 30- and 40-foot levels. Two-hundred and twenty feet along the sight line, there is a dual road that runs off 45 degrees to the right of the sight line. Cyclone fence, on both sides of the depressed road, is in close proximity to the sight line at points 220 and 400 feet from the transmitter site. Beyond the farther fence, there are trees 40 feet tall located on a downward slope.



Figure 20. Evans Area "F" Site 20

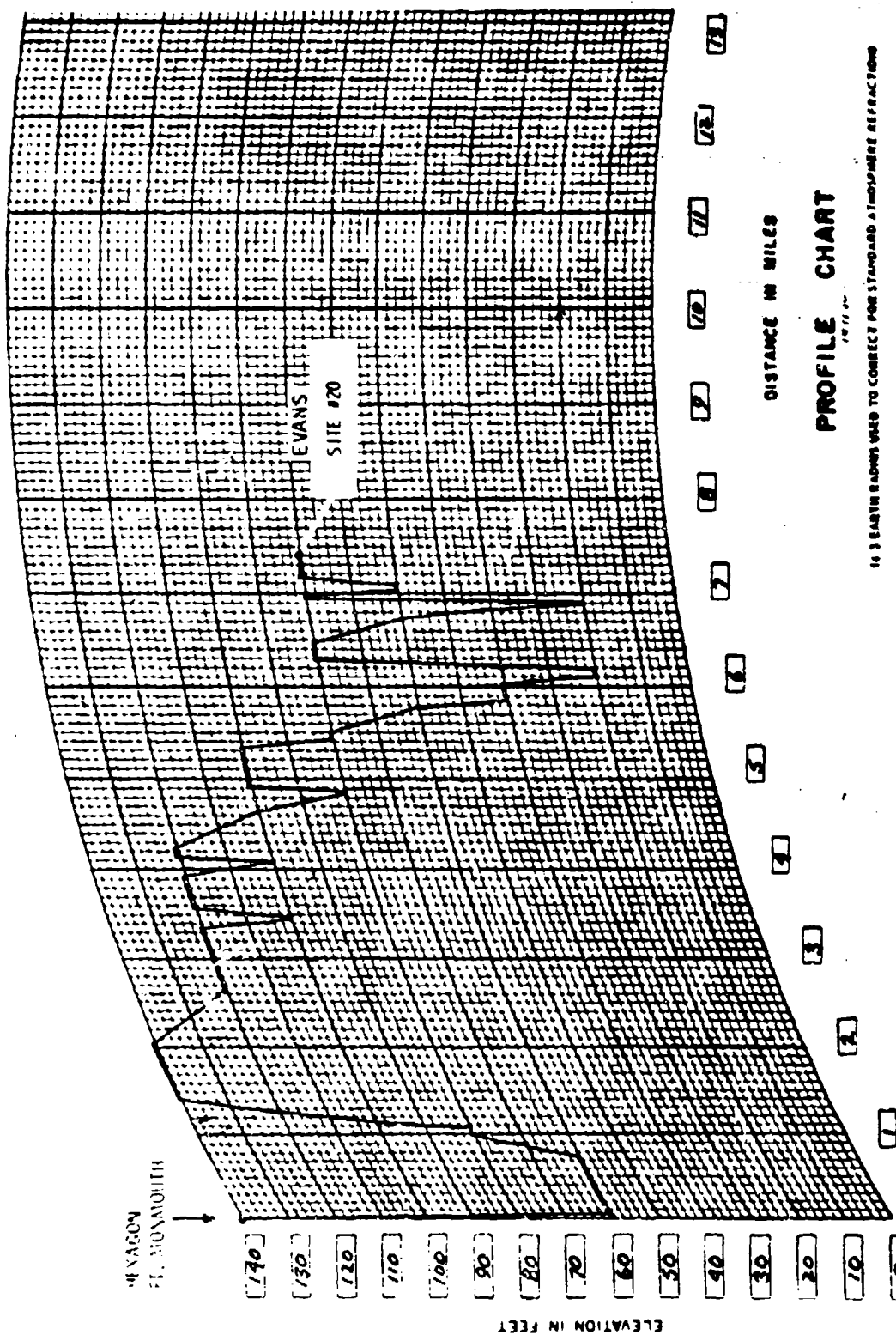


Figure 21. Site 20 Profile Chart



## 7. SAMPLE DATA

This paragraph contains a complete sample data run and data reduction in order to illustrate the procedures used and to enable the reader to better interpret the data contained in paragraphs 8 and 9. The examples are excerpts from the tests conducted on February 9, 1972.

Figure 22 is a sample of the test condition log, which is generally self-explanatory. Tests were normally conducted with vertical polarization on both the transmit and receive ends, unless otherwise noted. This log sheet indicated that test runs 720209-01 and 720209-02 were done with vertical polarization, and that in run 720209-03, horizontal polarization was used in the transmitting antenna. The receiving antenna was always vertically polarized.

Figures 23 and 24 are full-size reproductions of the strip chart recording of run 720209-02. It shows that the run was started at 1350 hours, the AEL horn antenna was used, and the frequency was 1,545 MHz. The wind was from 270 degrees at 2 knots, gusting to 8 knots. The lower section of the strip chart has the calibration marks on it, showing the -80, -90, -100, and -100 dBm levels. The wiggly line is the recorded signal strength and the annotations on the upper section show the height of the transmitting antenna. The notation 10 dB ATT between 8 and 30 feet indicates the signal was attenuated 10 dB. In order to place the trace into the most linear section of the recording equipment, attenuation was added whenever the signal strength was of such a magnitude that it would cause the trace to fall near the edge of the recording. During the portion of the test run between 30 and 65 feet, 20 dB of attenuation was added. Obviously, these attenuation values have to be added to the signal strength read from the graph. The test ended at 1,400 hours, as indicated, and the equipment was recalibrated at the end of the test to assure us that nothing had drifted sufficiently to invalidate the data.

Figure 25 shows a Test Data Sheet, which is used for establishing path losses with the data from the strip chart recording. As shown in the section on the upper right of this sheet, the equivalent system (input) power is a function of the transmitted power, the antenna gains, and cable losses. The received signal strength is scaled off the strip chart recording and logged in the RCVD PWR column as a function of transmitting antenna height above ground. This particular test data sheet shows the data from two consecutive runs. It should be noted that the received power in dBm was always negative, but for simplicity's sake, the negative signs were omitted on these sheets. The path loss for each test is shown in the next two columns, and the average path loss for each transmitting antenna height together with the number of samples this average is based on, is shown in the last two columns.

Figure 26 is a plot of the average path losses found in test runs 720209-01 and -02, as determined on the test data sheet. The free space loss between the transmitting and receiving stations is also shown. This lets one determine the additional path loss, above that of free space, caused by the physical environment through which the signal is propagated.

# TEST SET-UP AND CONDITIONS

DATE: 9 FEBRUARY 72

TYPE OF TEST: RANGING

PATH LOSS: ✓

CONDITION	TEST RUN S/N <u>720209-01</u>	TEST RUN S/N <u>720209-02</u>	TEST RUN S/N <u>720209-03</u>
TRANSMITTER			
OPER. FREQ.	<u>1545</u>	<u>1545</u>	<u>1545</u>
SITE LOCATION	<u>WAYSIDE 19B</u>	<u>WAYSIDE 19B</u>	<u>WAYSIDE 19B</u>
ANTENNA TYPE	<u>REL HORN</u>	<u>REL HORN</u>	<u>REL HORN</u>
POWER (dBm)	<u>44</u>	<u>44</u>	<u>44</u>
ANTENNA GAIN (dB)	<u>14.4</u>	<u>14.4</u>	<u>14.4</u>
CABLE TYPE	<u>FHJ-4</u>	<u>FHJ-4</u>	<u>FHJ-4</u>
(a) LENGTH (FT)	<u>129</u>	<u>129</u>	<u>129</u>
(b) LOSS (dB)	<u>5.7</u>	<u>5.7</u>	<u>5.7</u>
RECEIVER			
ANTENNA TYPE	<u>ANDREW</u> <u>BICONICAL</u>	<u>ANDREW</u> <u>BICONICAL</u>	<u>ANDREW</u> <u>BICONICAL</u>
ANTENNA GAIN (dB)	<u>0.3</u>	<u>0.3</u>	<u>0.3</u>
CABLE TYPE	<u>RG319A/U</u>	<u>RG319A/U</u>	<u>RG319A/U</u>
(a) LENGTH (FT)	<u>130</u>	<u>130</u>	<u>130</u>
(b) LOSS (dB)	<u>1.2</u>	<u>1.2</u>	<u>1.2</u>
WIND	<u>2-4 G V 270°</u>	<u>2-4 G 8 270°</u>	<u>2-4 G 10 270</u>
TEMP.	<u>29°F</u>	<u>29°F</u>	<u>29°F</u>

REMARKS: RUN 720209-03  
HORIZONTAL POLARIZATION

OPERATORS: D. LACLAIR XMTR.

J. VANGA RCVR.

Figure 22. Typical Test Sheet

# PROPAGATION PATH LOSS

DATE: 2/1/72 TEST RUN S/N: 120209-02

PATH: WYSS DE SITE NO. 128 TO ECCN' HEX 05-11

OPER. FREQ.: 1545 MHz

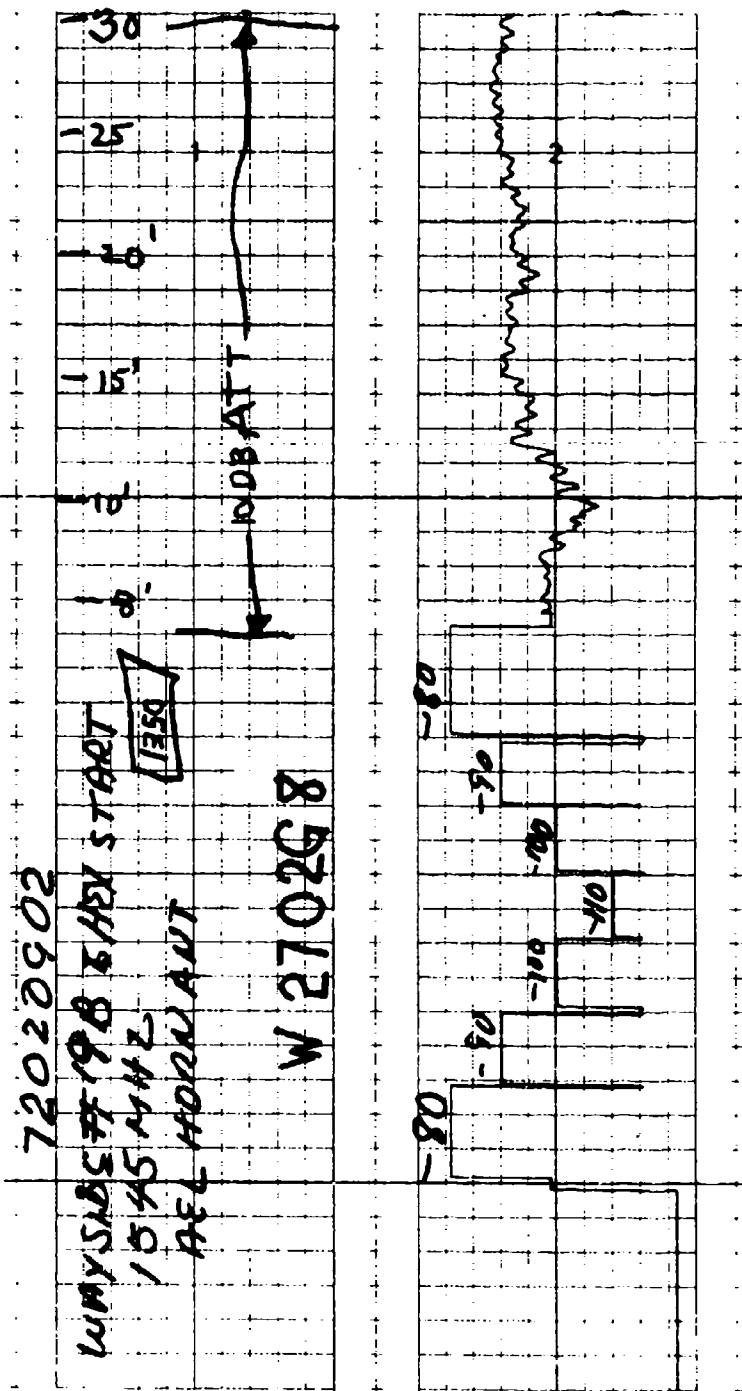


Figure 23. Propagation Path Loss Strip Chart

# PROPAGATION PATH LOSS

DATE: 9 FEBRUARY 72 TEST RUN S/N: 720209-02

PATH: WAYSIDE SITE No. 198 TO ECOM 1/EXAGON

OPER. FREQ.: 1545 MHZ

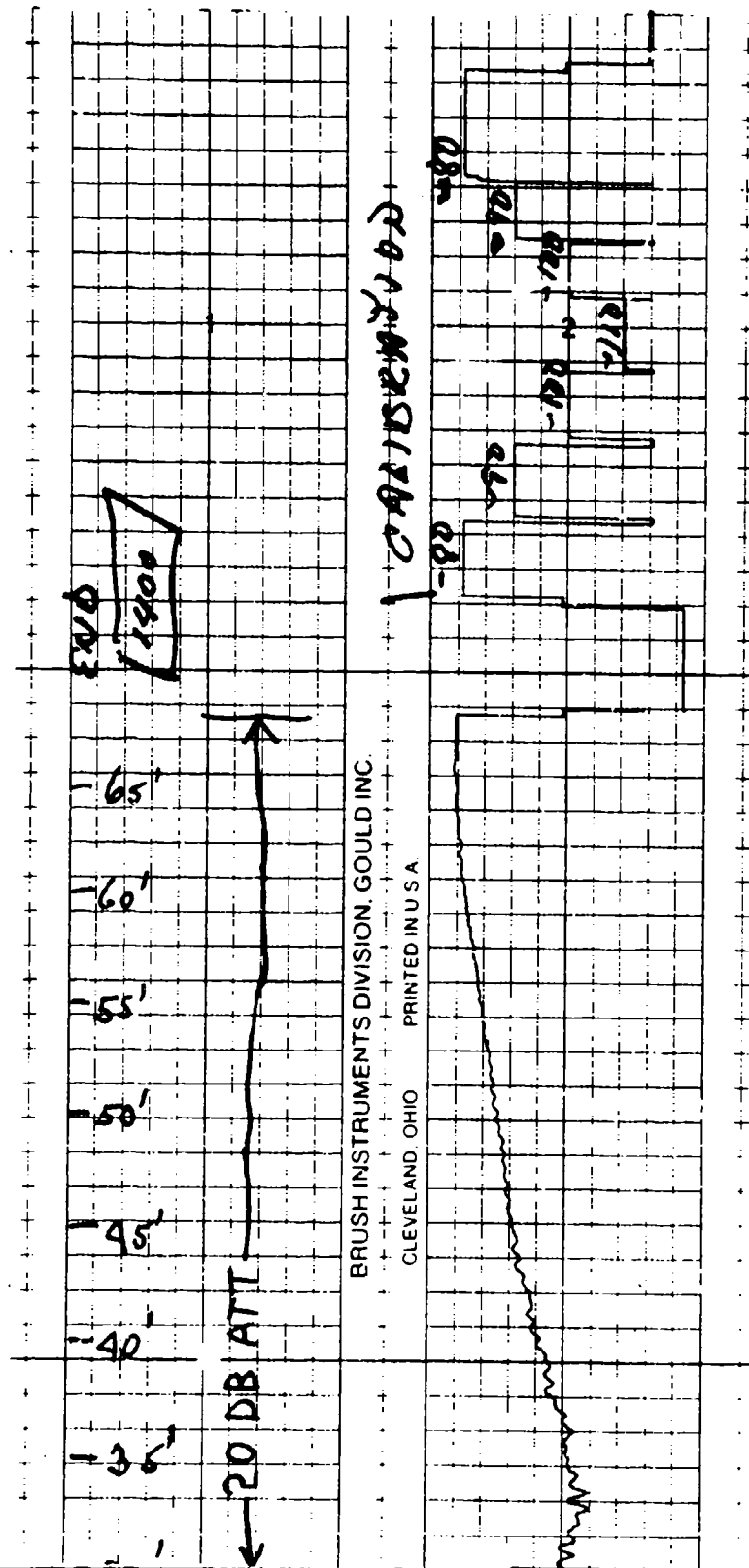


Figure 24. Propagation Path Loss Strip Chart

TEST DATA SHEET									
OPER. FREQ.		154.5 MHz		DATE: 9 FEBRUARY 72		START: 1328 HRS.		FT.	
SITE		LOCATION		REC. SITE ANT. HT.		ANT. GAIN (dB)		EQUIV. SYS. PWR. (ESP)	
TRANSMITTER		WAYSIDE 190		ANTENNA		14.4		XMITR. PWR. 44	
RECEIVER		ECOM HEX.		HORN		0.3		+ANT. GAINS 14.7	
TOTAL ANT. GAIN (XMITR + REC.)		14.4 + 0.3 = 14.7 dB						-CABLE LOSSES 6.9	
TOTAL CABLE LOSS (XMITR + REC.)		5.7 + 1.2 = 6.9 dB						-ESP = 5.8 USE $\sqrt{2}$	
XMITR. SITE HEIGHT ABOVE SEA LEVEL		140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140 FT.			
ANT. HT. ABOVE GND (FT)	TEST	RCVD. PWR. (dBm)	TEST	TEST	PATH LOSS (dB) = (ESP) - (RCVD. PWR.)	AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS	
8	720209-01	97	88	720209-02	141	141.5	2		
10	96	92	82	140	146.0	2			
15	82	82	82	134	134.0	2			
20	85	83	83	137	136.0	2			
25	80	80	80	132	132.0	2			
30	81	81	81	133	133.0	2			
35	81	81	81	133	133.0	2			
40	76	75	75	128	127.5	2			
45	72	70	70	124	123.0	2			
50	68	68	68	120	120.0	2			
55	65	65	65	117	117.0	2			
60	62	62	62	114	114.0	1			
65	60	60	60	112	112.0	1			
								END 720209-01 - 1335	
								START 720209-02 - 1350	
								END 720209-02 - 1400	
MEAN READING OF STRIP CHART RECORDINGS									

Figure 25. Typical Test Data Sheet

PROPAGATION PATH LOSS  
DATE: 9 FEBRUARY 72 TEST RUN S/N: 720209-01-02  
PATH: WAYSIDE SITE No. 19B TO ECOM HEXAGON

OPER. FREQ.: 1545 MHz

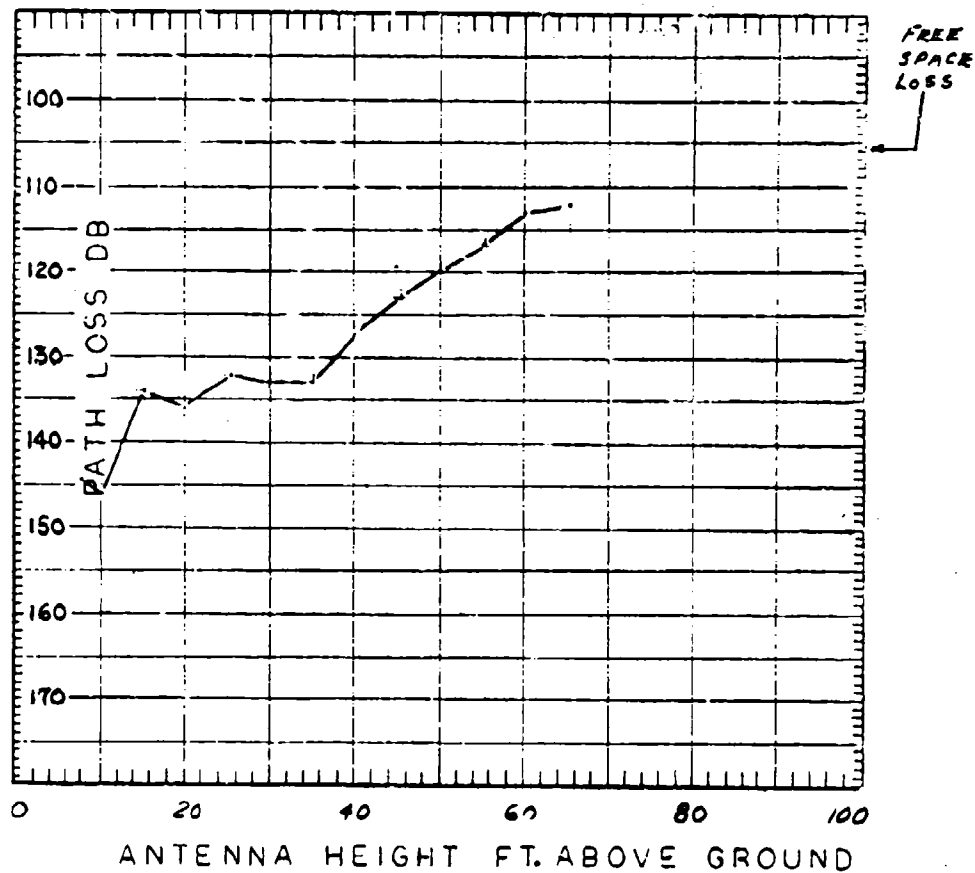


Figure 26. Propagation Path Loss Graph

## 8. TEST RESULTS

This paragraph contains the reduced data from the tests (refer to the Appendix). The raw data is not included in this report since it would unnecessarily add to the bulk. The results of each set of tests are shown in tabulated and graphical formats. The explanation of how this reduced data was obtained is given in the "Sample Data," paragraph 7.

Table V lists the distribution and cumulative distribution of the maximum path losses obtained during the 1972 tests. Only three of the four frequencies used in the test are shown since there was insufficient data at the highest frequency. This data was obtained over the various paths between the receiver at the Hexagon Building, Fort Monmouth, and the transmitting stations, none of which were more than 10 miles from the receiver. It should be noted here that the maximum path loss did not always occur at the lowest antenna height. The table shows the number of tests in which particular maximum losses were observed, the cumulative total as the losses get larger and larger, and the percentage of the total number of observations that these cumulative totals represent. This data is plotted on Figures 27 and 28.

Figure 27 shows the distribution of the maximum path losses. It can be seen that as the frequency is increased, the path losses increase. The cumulative distribution plot, Figure 28, shows the percentage of path loss which does not exceed a given loss, as a function of antenna height and frequency. For example, at 1,545 MHz, 96 percent of the transmissions had a path loss of 151 dB or less, regardless of antenna height, obstructions, atmospheric conditions, etc. (without our 10-mile test radius of course).

The graphs on the following pages are combinations of various plots selected from the reduced data in the Appendix. These graphs were prepared to allow comparative analysis of typical test runs and contain such combinations as different days and seasons at the same location and the same frequency, different frequencies at the same location, different antennas at the same location and same frequency, and different polarizations over the same path under identical test conditions.

Table V. Path Loss - 1972 Low Points

1545				371.4				229.5			
dB	#	Cum	Z	dB	#	Cum	Z	dB	#	Cum	Z
124	3	3	12	109	1	1	8	105	1	1	8
132	1	4	15	122	1	2	15	114	1	2	17
134	1	5	19	123	2	4	31	117	1	3	25
137	2	7	27	124	1	5	39	120	1	4	33
140	1	8	31	126	1	6	46	122	1	5	42
141	1	9	35	127	2	8	62	123	1	6	50
142	3	12	46	129	1	9	69	125	3	9	75
143	1	13	50	130	1	10	77	127	1	10	83
144	3	16	62	132	2	12	92	129	11	11	92
146	1	17	65	133	1	13	100	134	1	12	100
147	3	20	77								
148	2	22	85								
149	1	23	89								
150	1	24	92								
151	1	25	96								
156	1	26	100								



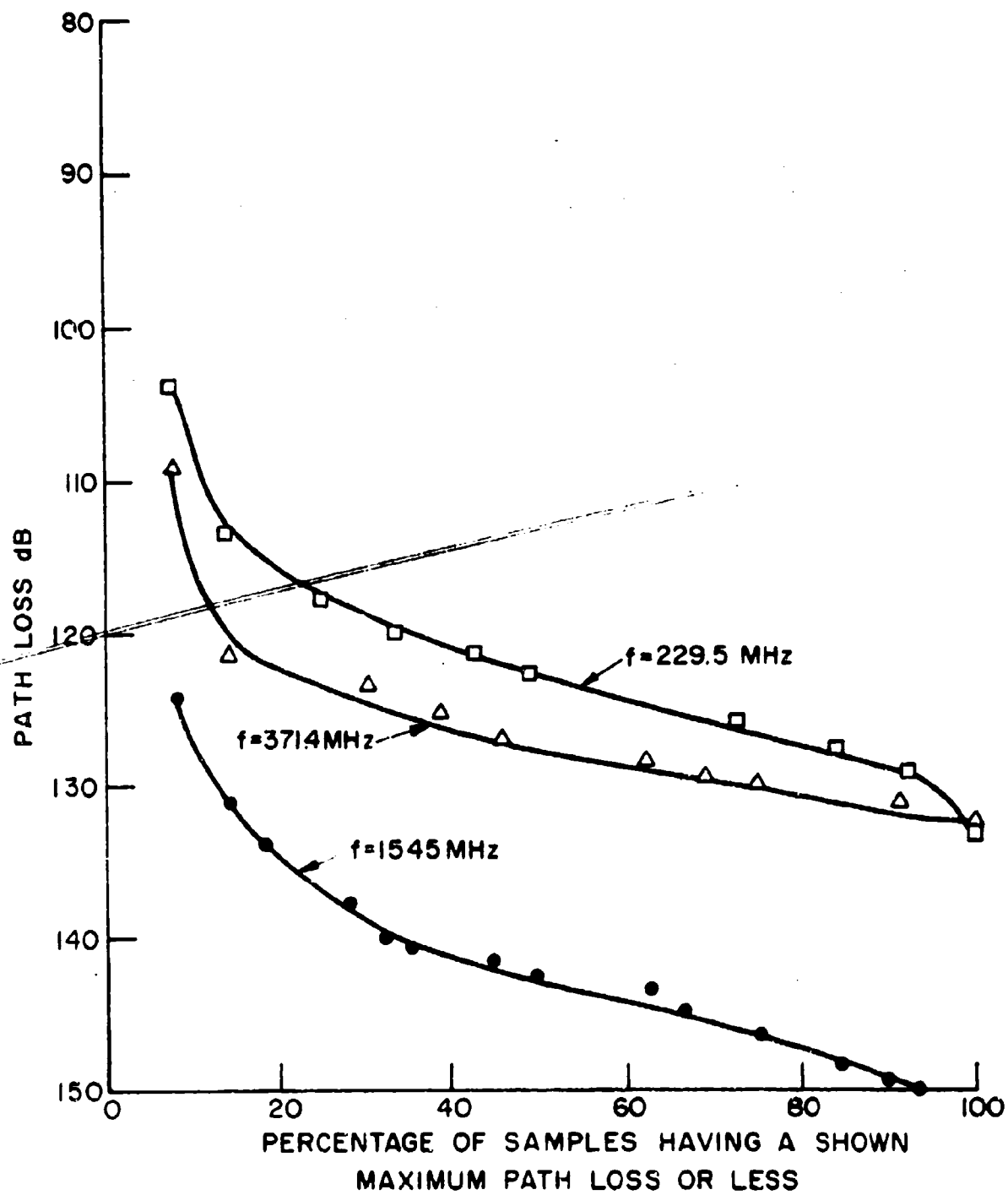


Figure 27. Propagation Path Loss 1,545 MHz

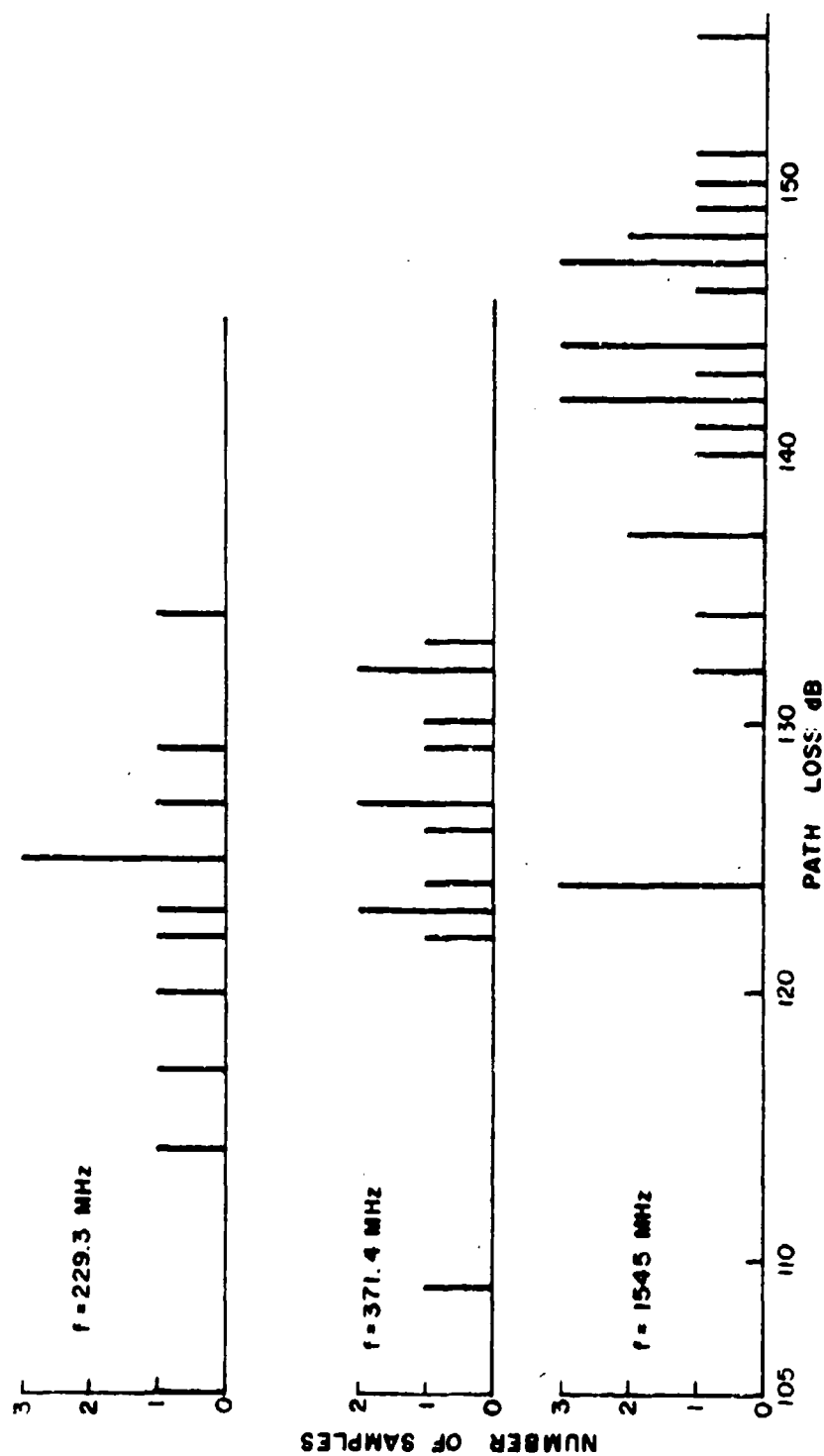


Figure 28. Propagation Path Loss 371.4 MHz

a. 229.5 MHz Comparison Plots (Figures 29 through 32)

Wayside Site No. 9 to ECOM Hexagon 1.61 miles  
Oper. Freq. 229.5 MHz, Ant. Type: AT-197

See description of Site 9 for details - Beyond line-of-sight and blocked by trees without leaves except for pines.

18 Feb. 1972 -----

14 Mar. 1972 -----

These results of the measurements do not differ by more than 3 dB and there is reasonably good correlation.

The path loss is about 27 dB greater than the free space path loss at antenna heights between 10 to 30 feet.

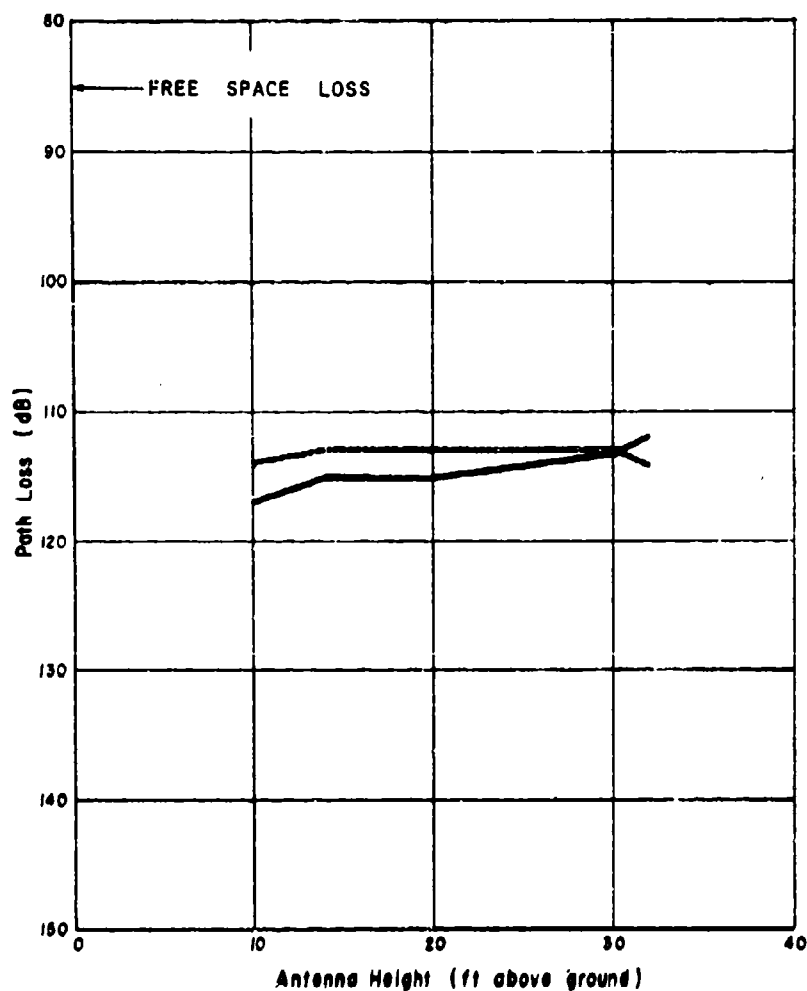


Figure 29. Propagation Path Loss (Site 9 to Hexagon, Frequency 229.5 MHz, Antenna AT-197)

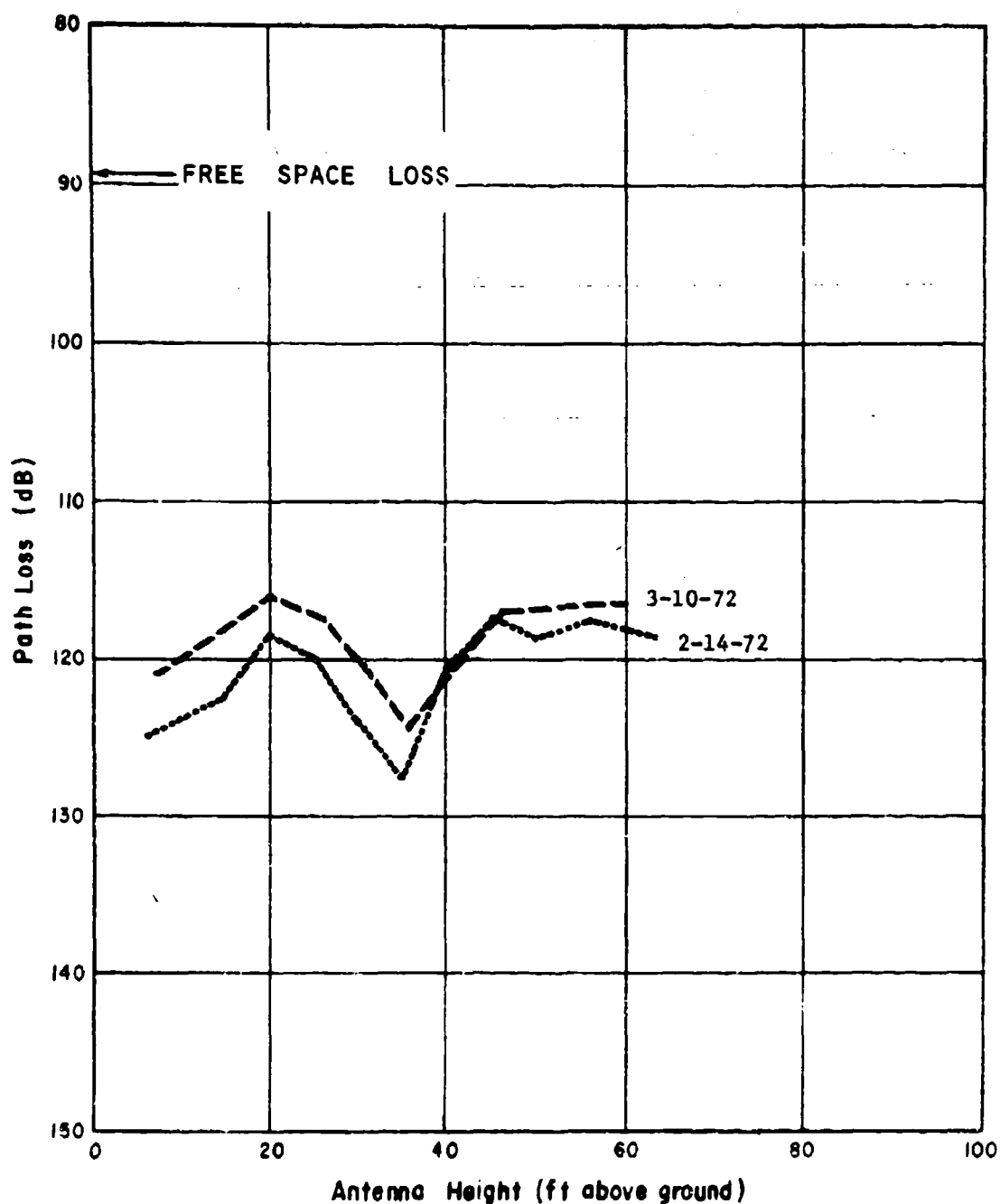


Figure 30. Propagation Path Loss (Site 19B to Hexagon, Frequency 229.5 MHz, Antenna T-29 (Horizontal))

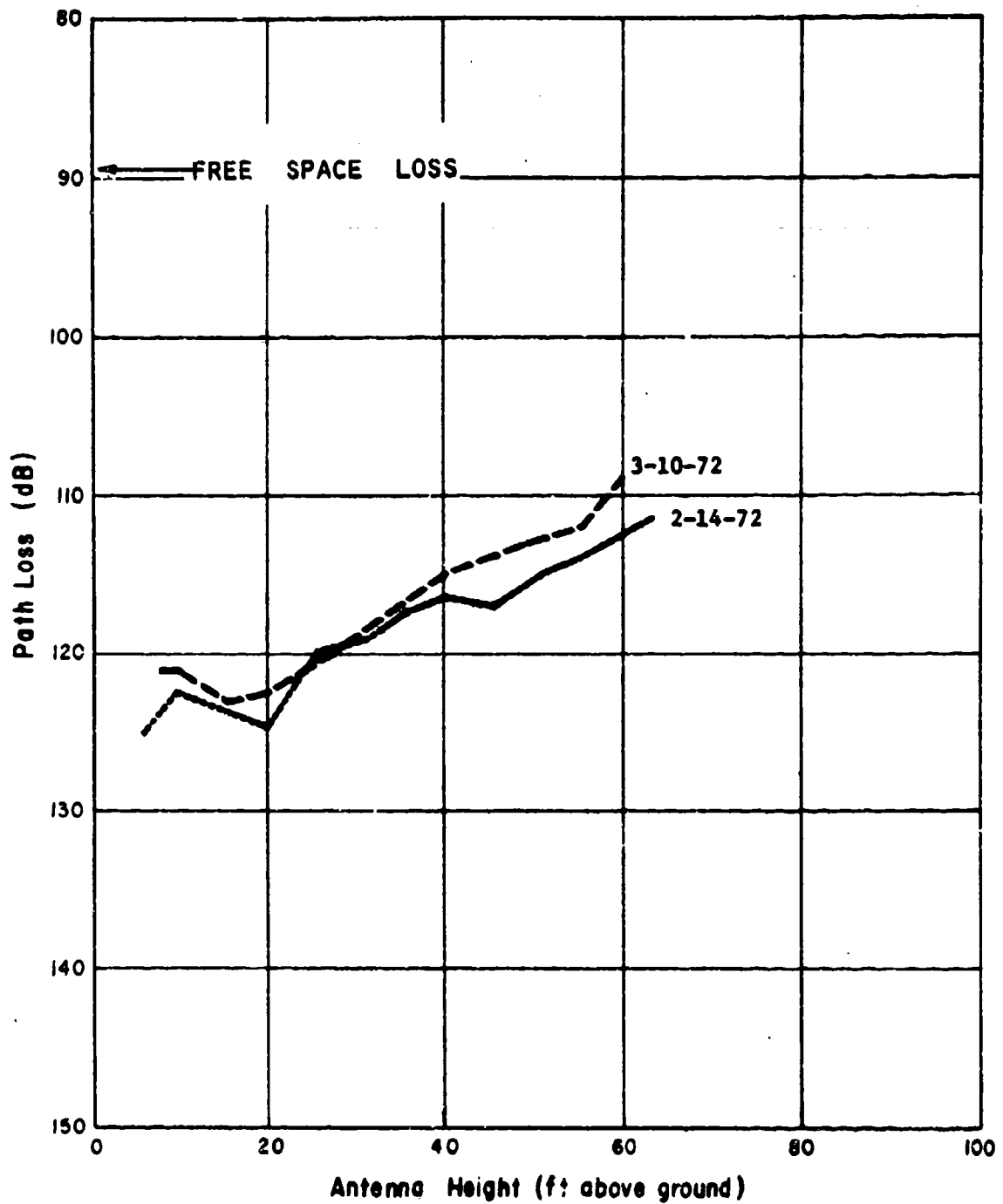


Figure 31. Propagation Path Loss (Site 19B to Hexagon, Frequency 229.5 MHz, Antenna T29 (Vertical))

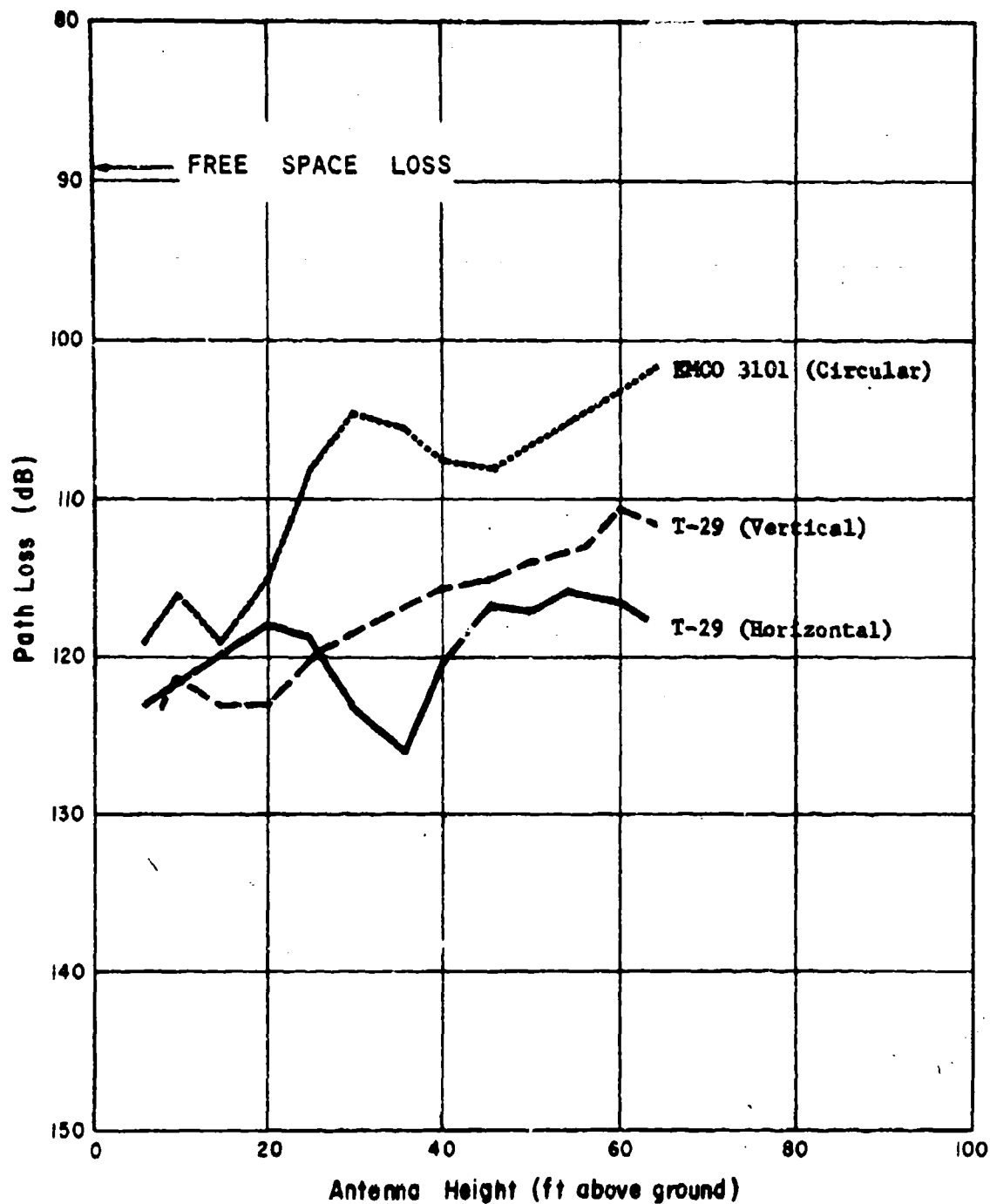


Figure 32. Propagation Path Loss (Site 19B to Hexagon, Frequency 229.5 MHz Antenna) (See Graph, Figure 3)

b. 371.4 MHz Comparison Plots (Figures 33 through 41)

(1) Path AKL MCA No. 5 to ECOM Hexagon.

Oper. Freq. 371.4 MHz Ant. Type - AT-197

Oct. 1971 - ——— Leaves still on trees.  
 27 Jan. 1972 - - - - - Dry ground, no leaves on trees, tractors moving about 600 feet in front of transmitting antenna.  
 28 Jan. 1972 - - - - - 2-1/2 inches of snow on ground with light snow falling - wind 1 to 2 knots gusting to 4 - transmitting antenna had a light coat of ice - no tractor activity.

At this site, the transmitter is beyond the line of sight and at a distance of 7.6 miles from the Hexagon. The maximum data spread of 3 dB occurs at an antenna height of 40 feet. At 60 feet antenna height, the data spread is 4 dB.

The above data spreads are not considered excessive.

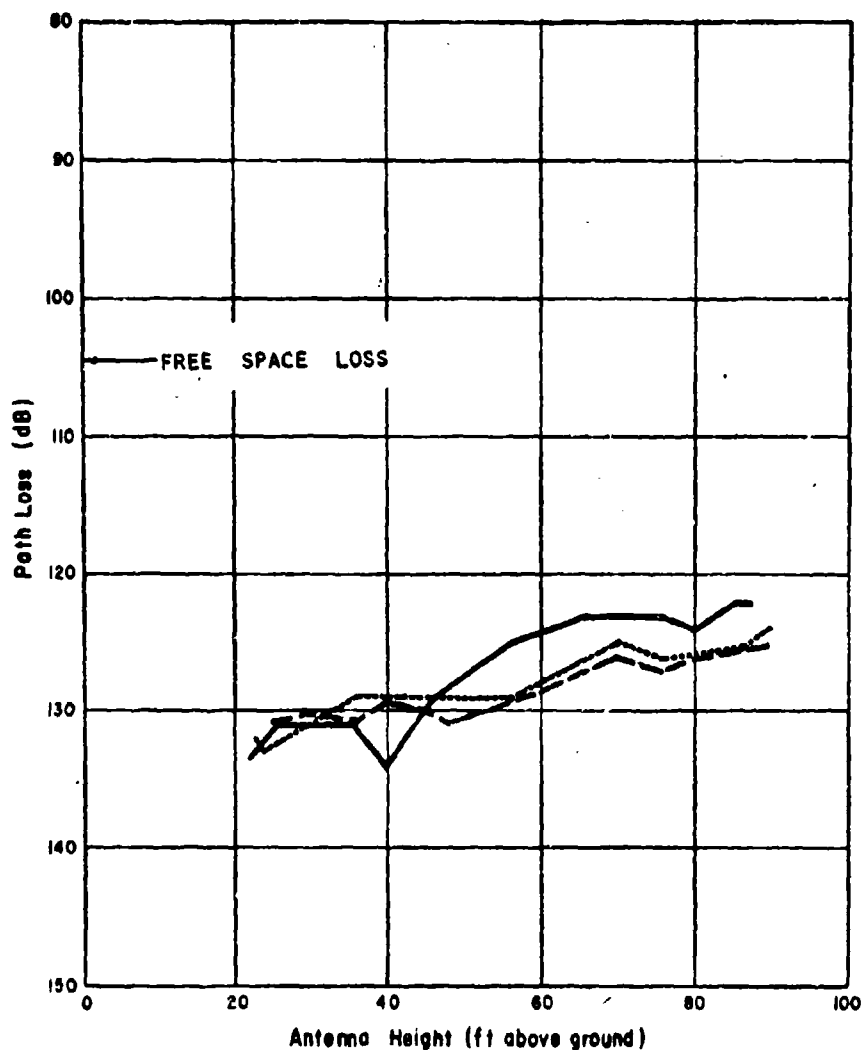


Figure 33. Propagation Path Loss (Site 5 to Hexagon, Frequency 371.4 MHz, Antenna AT-197)

(2) Path, Wayside Site No. 9 to ECOM Hexagon - 1.61 miles.

Oper. Freq. 371.4 MHz Ant. Type: AT-197

See description of site No. 9 for details - Beyond line-of-sight and blocked by pine trees and trees without leaves.

9 Nov. 71 - — — — — —

18 Feb. 72 - - - - -

14 Mar. 72 - — — — — — Rain and sleet on this day.

On 18 February and 14 March, between 17 and 32 feet of antenna height the difference in path loss does not differ by more than 2 dB. At 32 feet, the difference is 3 dB. Below 17 feet, the difference increases to as much as 9 dB at 10 feet of antenna height. At 30-foot antenna height, the path loss is about 23 dB below the free space loss.

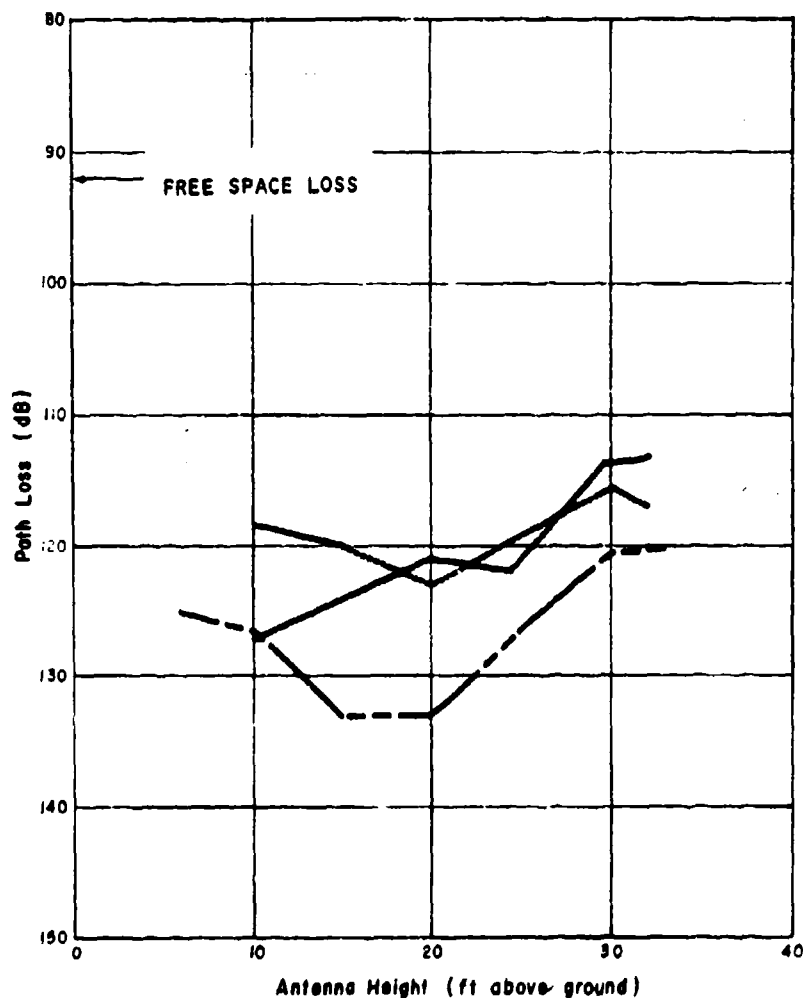


Figure 34. Propagation Path Loss (Site 9 to Hexagon, Frequency 371.4 MHz, Antenna AT-197)



(3) Path: Wayside Site No. 19 to ECOM Hexagon - 1.68 miles.

Oper. Freq. 371.4 MHz Ant. Type: AT-197

15 Nov. 1971 -	-----	} On the average, these data subject to greater path loss at heights of 20 to 30 feet.
16 Nov. 1971 -	-----	
19 Nov. 1971 -	-----	
7 Feb. 1972 -	-----	} These data more self-consistent at all heights from 10 to 32 feet.
10 Mar. 1972 -	-----	
10 Mar. 1972 -	-----	

Within range of heights from 7 to 33 feet, the data indicated a path loss variation of 22 dB. For the 7 February and 10 March data, the path loss variation was reduced to 16 dB.

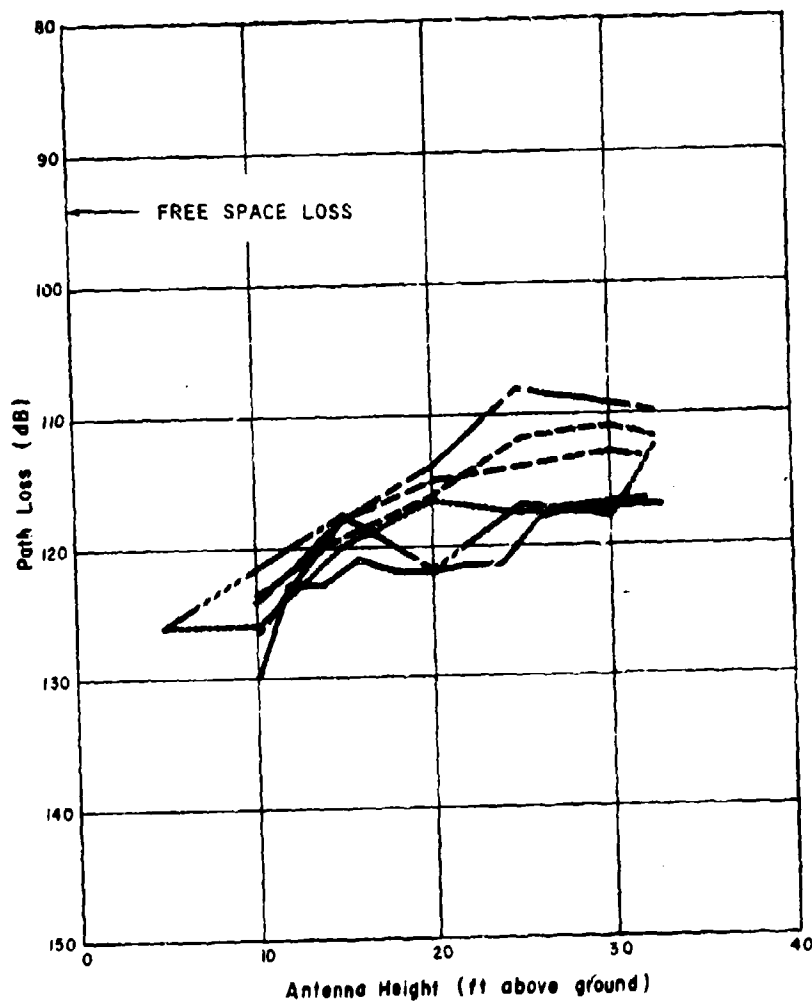


Figure 35. Propagation Path Loss (Site 19 to Hexagon, Frequency 371.4 MHz, Antenna A1-197)

(4) Path: Wardside Site No. 19B to ECOM Hexagon.

Oper. Freq. 371.4 MHz

Three additional plots are included to provide data for the composite plot for comparing the performance when signals are transmitted in horizontal, vertical, and circular polarisation modes.

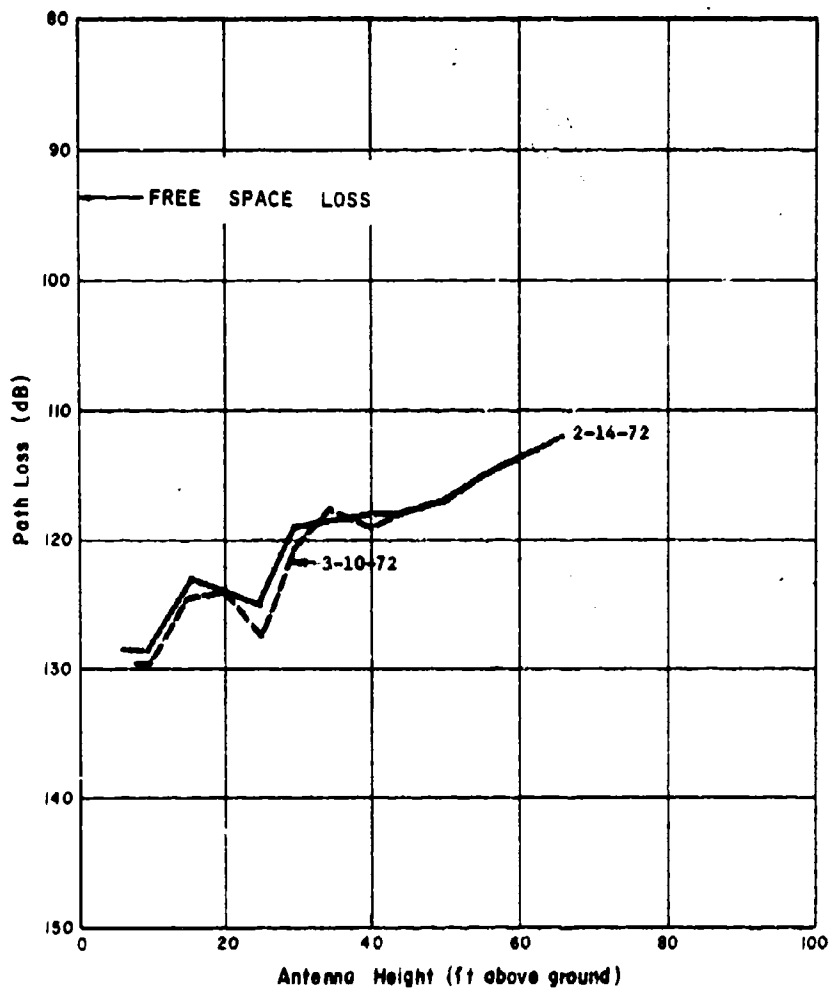


Figure 36. Propagation Path Loss (Site 19B to Hexagon, Frequency 371.4 MHz, Antenna T-29 (Horizontal))

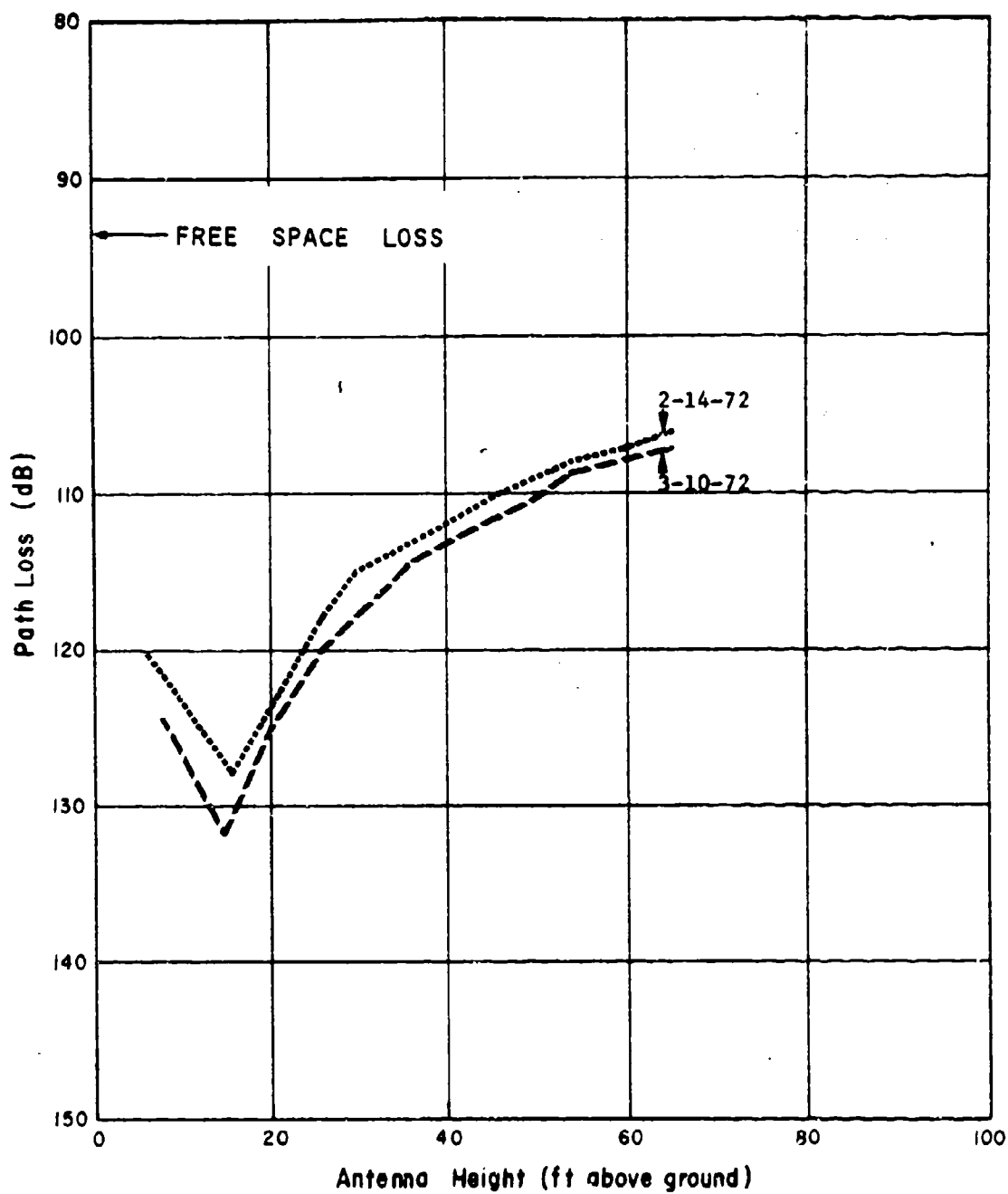


Figure 37. Propagation Path Loss (Site 19B to Hexagon, Frequency 371.4 MHz, Antenna T-29 (Vertical))

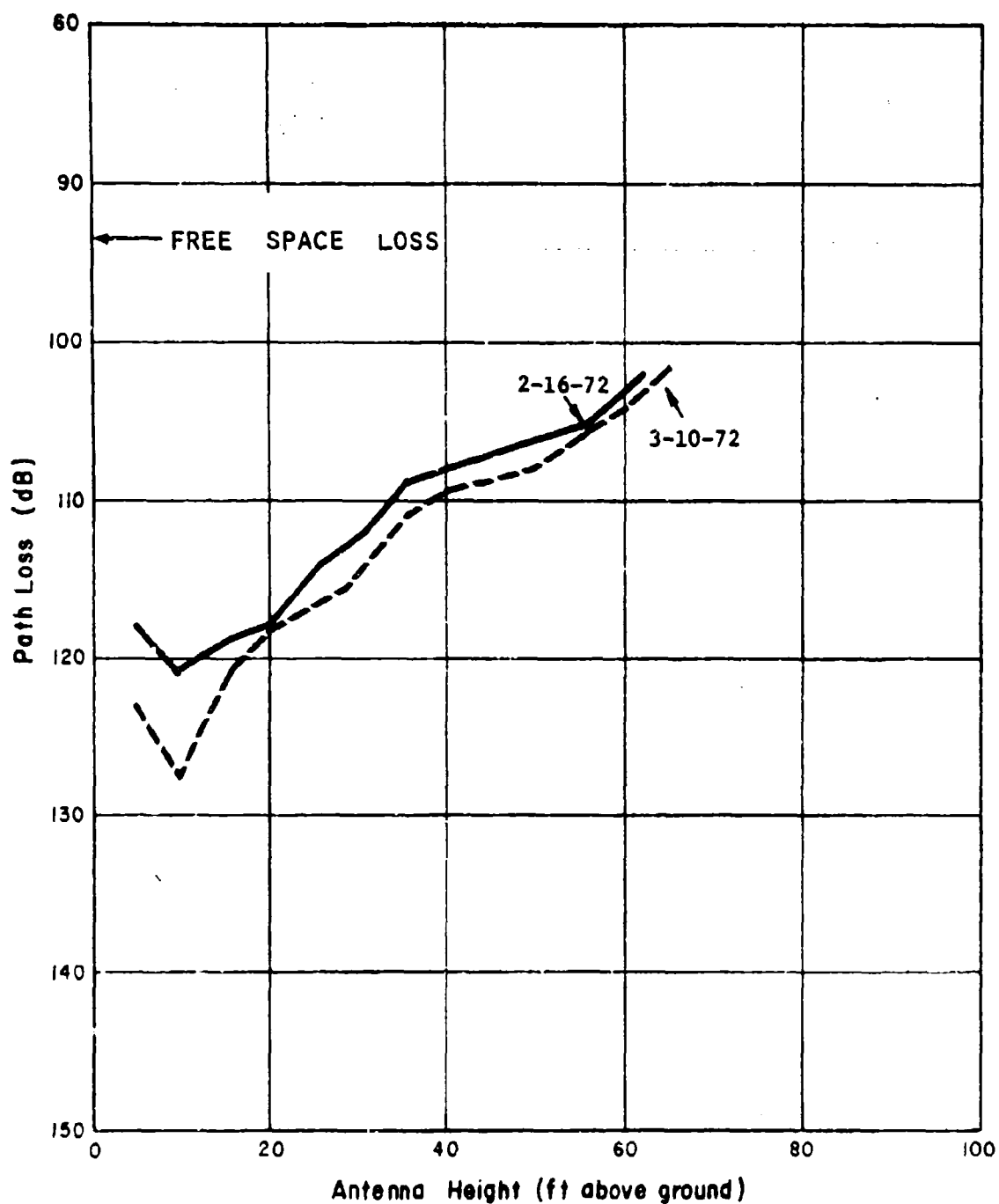


Figure 38. Propagation Path Loss (Site 19B to Hexagon, Frequency 371.4 MHz, Antenna EMCO 3101 (Circular))

(3) Path Wayside Site No. 198 to the Hexagon - 1.86 miles.

Oper. Freq. 371.4 MHz Ant. Type - See Graph

At this frequency, the circularly polarized EMCO Model 3102 log spiral antenna was compared with the linearly polarized T-29 log periodic antenna in both horizontal and vertical polarizations. On this path, the path loss was less by 2 to 12 dB at all transmitting antenna heights from 3 to 62 feet using the circularly polarized antenna as compared to the T-29 in either polarization. Between 20 and 62 feet, the depolarization effect in horizontal polarization causes 0 to 8 dB greater loss than in the vertically polarized case. In either case, the received signal is less than when a circularly polarized antenna is used. This indicates the possible advantage of employing circular polarization over tree covered terrain.

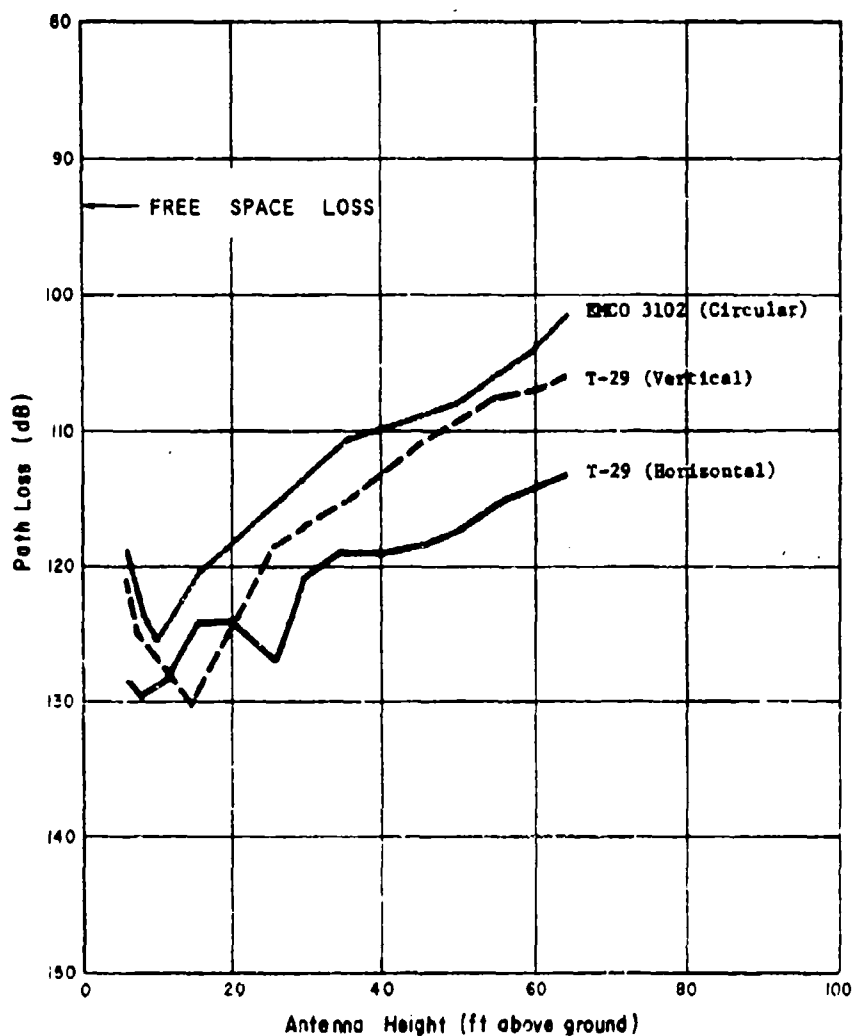


Figure 39. Propagation Path Loss (Site 198 to Hexagon, Frequency 371.4 MHz, Antenna (See Graph))

(6) Path: Wayside Site No. 19B to ECOM Hexagon.

Oper. Freq: 371.4 MHz Ant. Type: AT-197 - Omni-directional, Vertically Polarized

Although not included with the composite comparison of the effects of transmitting circularly, vertically or horizontally polarized signals on the vertically polarized receiving antenna, the comparative effect on path loss with the AT-197 is included in this discussion of the test data for 9 February and 10 March 1972.

As the height was changed from 4 to 63 feet, the path loss measurements for these two dates differed at heights greater than 20 feet by 2 to 4 dB. The maximum difference of 7 dB occurred at a height of 14 feet.

The range of path loss is between 11 and 33 dB greater than the free space path loss. This range of values is nearly the same as with the use of the T-29 in vertical polarization for the same operating conditions at the same transmitting to receiving transmission path.

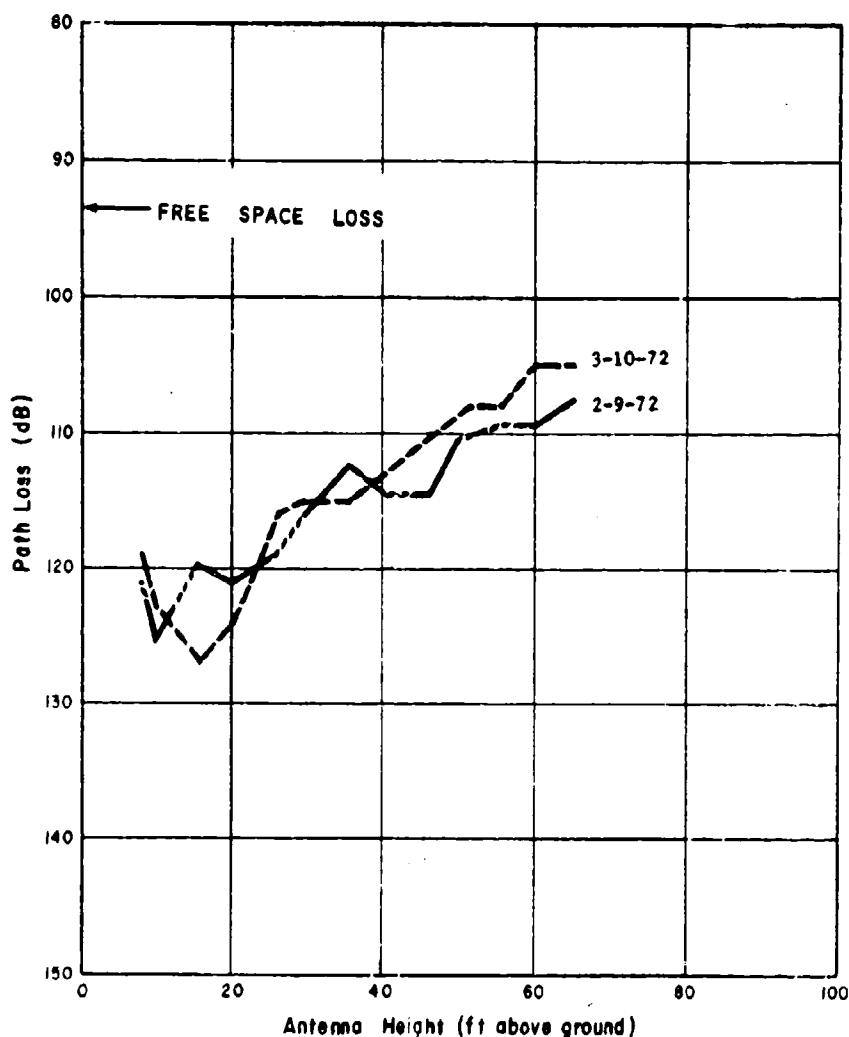


Figure 40. Propagation Path Loss (Site 19B to Hexagon, Frequency 371.4 MHz, Antenna AT-197)

(7) Highlands Site No. 21 to ECOM Hexagon

See Frequencies on Graph. Antenna Type - AT-197 - Discone

This path is within line of sight, 8.1 miles to Hexagon.

Objects in vicinity of the transmitting antenna:

Power line is in front about 50 feet away.

100-foot steel tower 33 feet away is to left and partially behind the antenna.

Storm fence and building is located adjacent to 100-foot steel tower.

Both measurements made 1 February 1972.

————— - 229.5 MHz

----- - 371.4 MHz

The ground is damp from melting snow.

Path loss variations are possibly subject to the influence of nearby objects.

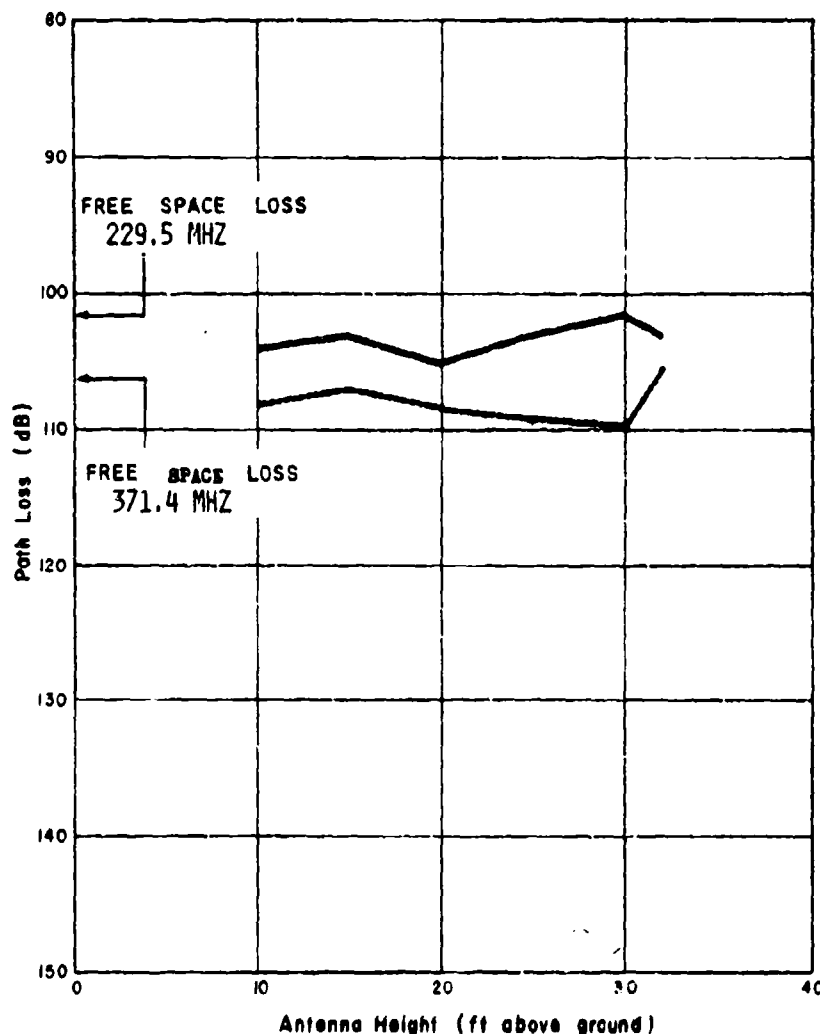


Figure 41. Propagation Path Loss (Site 21 to Hexagon, Frequency N/A, Antenna AT-197) 1 February 1972

c. 1,545-MHz Comparison Plots (Figures 42 through 51)

(1) Path AEL MCA Site No. 5 to ECOM Hexagon.

Oper. Freq. 1,545 MHz Ant. Type - AEL Horn

13 Oct. 71 - \_\_\_\_\_  
 19 Oct. 71 - - - - -  
 24 Jan. 72 - - - - - Tractors operating in line of sight about 600 feet away.  
 25 Jan. 72 - - - - - Light rain falling.  
 26 Jan. 72 - ..... Wind from 5 knots gusting to 20 knots.  
 27 Jan. 72 - ..... Equipment working in area.  
 28 Jan. 72 - - - - - Snow on ground, no snow falling, wind 1 to 2 knots.

There is a self consistency in these plots except for small deviations. Data spread varies from 3 dB at 60-foot altitude to about 6 dB at 38-foot altitude.

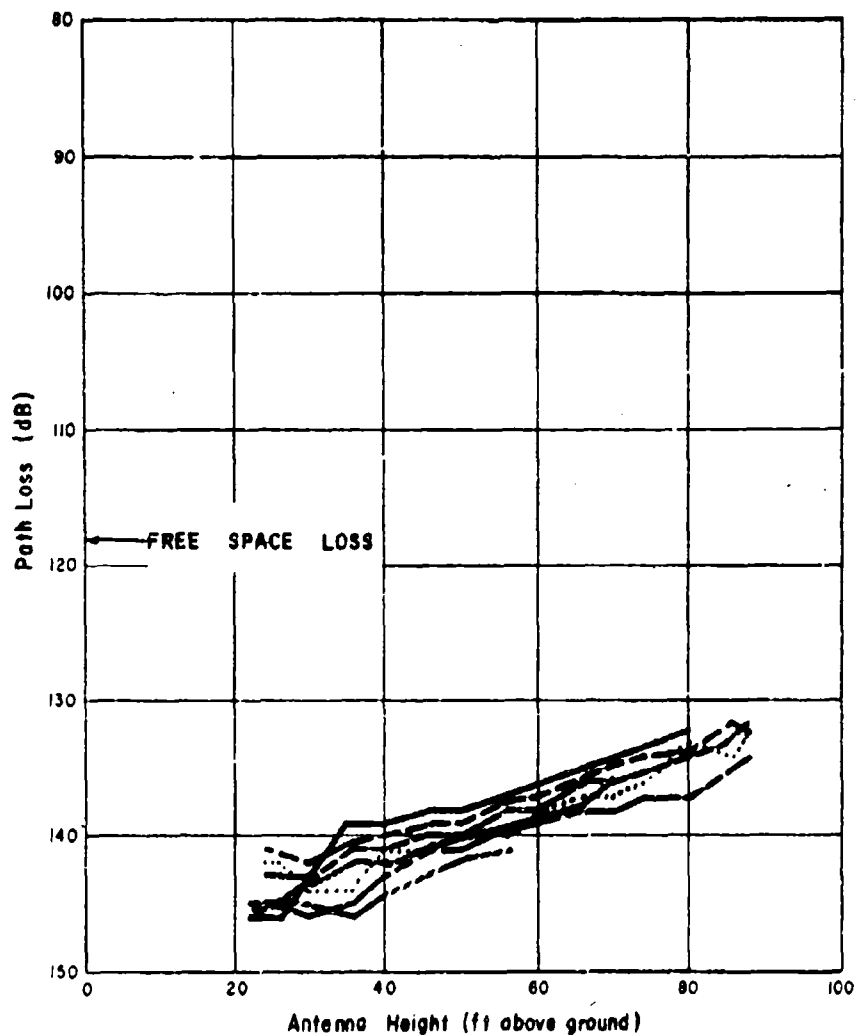


Figure 42. Propagation Path Loss (Site 5 to Hexagon, Frequency 1,545 MHz, Antenna - AEL Horn)



(2) Path Wayside Site No. 9 to ROOM Hexagon - 1.61 miles.

Oper. Freq. 1,545 MHz Ant. Type AEL Horn

See Description of Site No. 9 for details. Beyond line-of-sight and blocked by trees without leaves except for pines.

9 Nov. 1971 - - - - -

17 Feb. 1972 - - - - -

18 Feb. 1972 - - - - -

14 Mar. 1973 - - - - -

These three sets of measurements are self-consistent.  
Rain and sleet on 14 March.

The three sets of measurements taken in 1972 correlate reasonably well.

Differences are at most 3 dB.

Path loss is approximately 29 dB greater than free space loss at an antenna height of 30 feet and the loss increases by about 17 dB as the antenna is lowered to 7 feet.

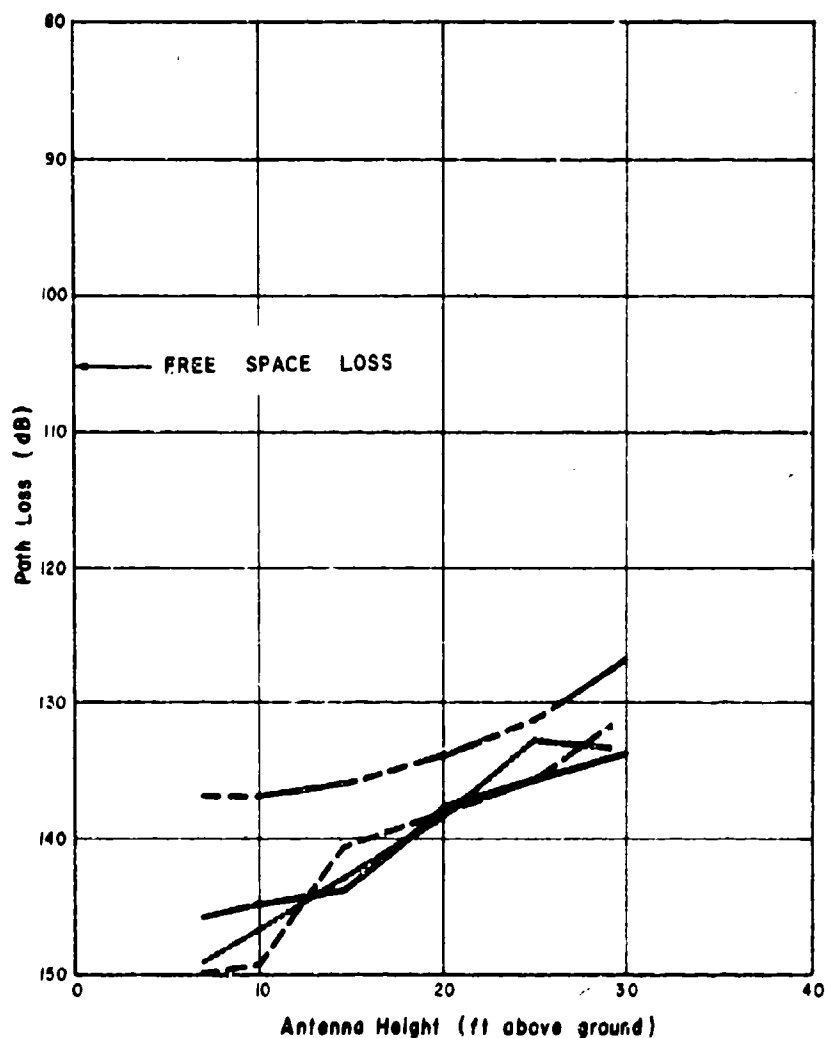


Figure 43. Propagation Path Loss (Site 9 to Hexagon, Frequency 1,545 MHz, Antenna - AEL Horn)

(3) Wayside Site No. 9 to BOOM Hexagon - 1.61 miles.

Oper. Freq. 1,545 MHz Ant. Type: Andrews Discone

See description of site 9 for details. Beyond line-of-sight and blocked by trees without leaves except for pines.

17 Feb. 72 - \_\_\_\_\_

18 Feb. 72 - - - - -

14 Mar. 72 - \_\_\_\_\_

The three test results correlate reasonably well. Differences are no more than 3 dB.

The path loss is about 27 dB greater than the free space path loss at 30-foot antenna height. Additional path loss of about 12 dB occurs as the antenna height is reduced to about 10 feet.

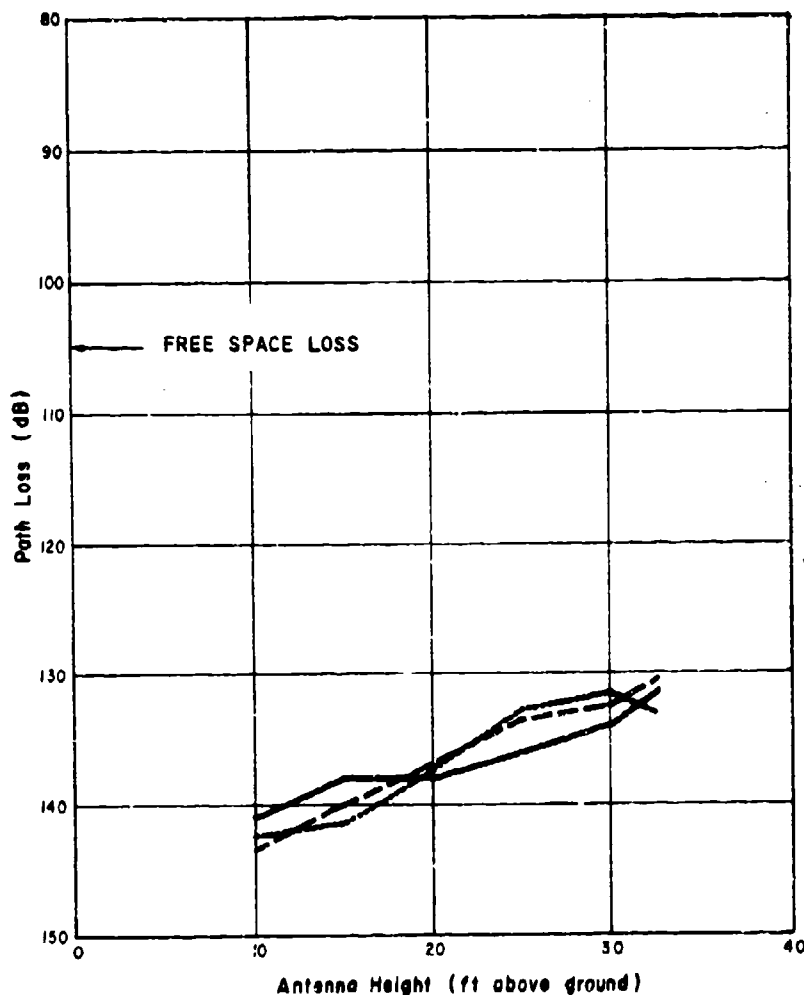


Figure 44. Propagation Path Loss (Site 9 to Hexagon, Frequency 1,545 MHz, Antenna - Andrews Discone)

(4) Path: Wavada Site No. 19 to NMM Hexagon - 1.69 miles.

Oper. Freq. 1,545 MHz Ant. Type: Andrews Discone

The propagation mode vertical polarization transmit to vertical polarization receive. The data is recorded for:

19 Nov. 1971 - \_\_\_\_\_  
 7 Feb. 1972 - - - - -  
 8 Feb. 1972 - - - - -  
 13 Mar. 1972 - - - - -

Data recorded on these 3 days more  
 self-consistent

The transmitter antenna height was varied from 10 to 32 feet. There are no known factors which can be used to explain why on 19 November 1971, there was a significant reduction in path loss in the 12- to 21-foot antenna height range.

The latter three runs differ over most of the height range by 2 to 4 dB. Above 30 feet high, the 7 February data does not retain consistency with the 8 February and 13 March data. In general, the last three data runs are not too dependent on antenna height. This differs with other data runs at 1,545 MHz which are much more dependent on transmitter antenna height. In general, the path loss over these heights is about 30 dB greater than free space path loss.

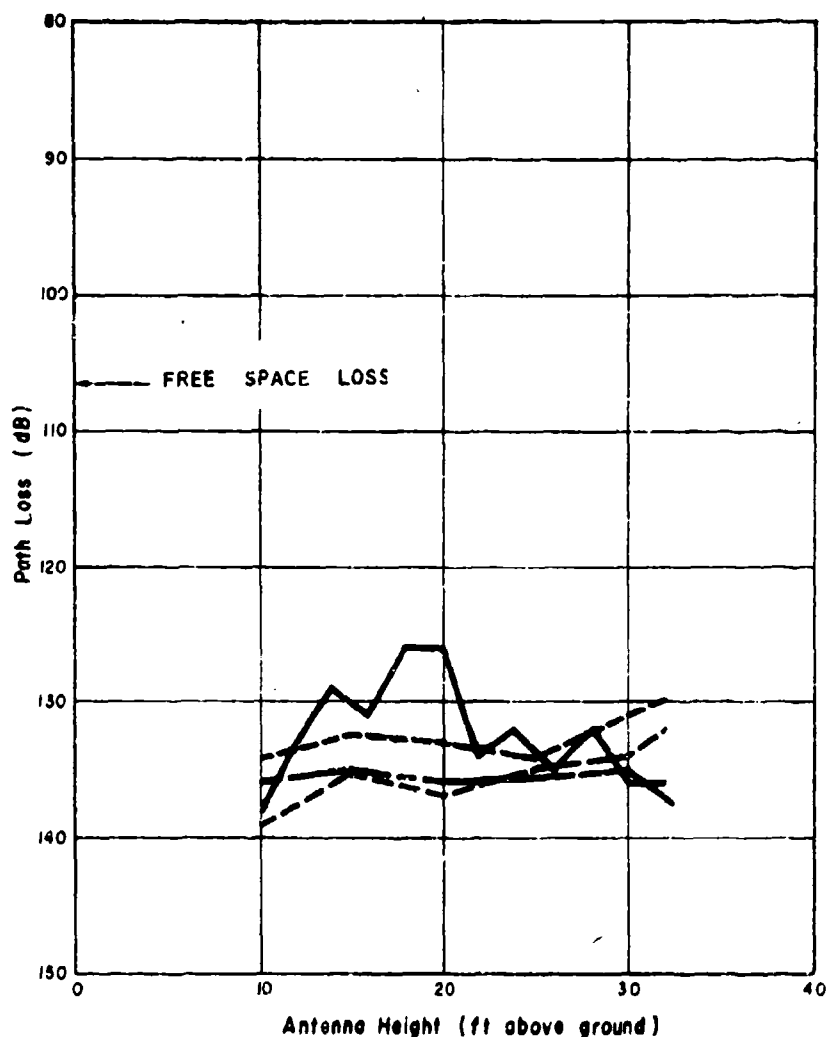


Figure 45. Propagation Path Loss (Site 19 to Hexagon, Frequency 1,545 MHz, Antenna - Andrews Discone)

(5) Path: Wayside Site No. 19 to ROOM Hexagon - 1.68 miles.

Oper. Freq. 1,345 MHz Ant. Type: AEL Horn

The antenna height was varied from 7 to 30 feet. Although the 13 November 1971 data (green) and the 8 February 1972 data (purple) were taken nearly three months apart, path losses with antenna heights between 7 and 25 feet are comparable. However, between 25 and 30 feet, the difference in path losses is as much as 9 dB. Although the leaves were mainly dead, there was a fair amount of leaf cover in November and none in February.

The 13 March 1972 data (red) were taken on a sleety, rainy day with very wet ground. The wet trees in the foreground may have added to the absorption loss and effectively increased the path loss.

In general, the path loss was about 30 dB greater than the free space loss.

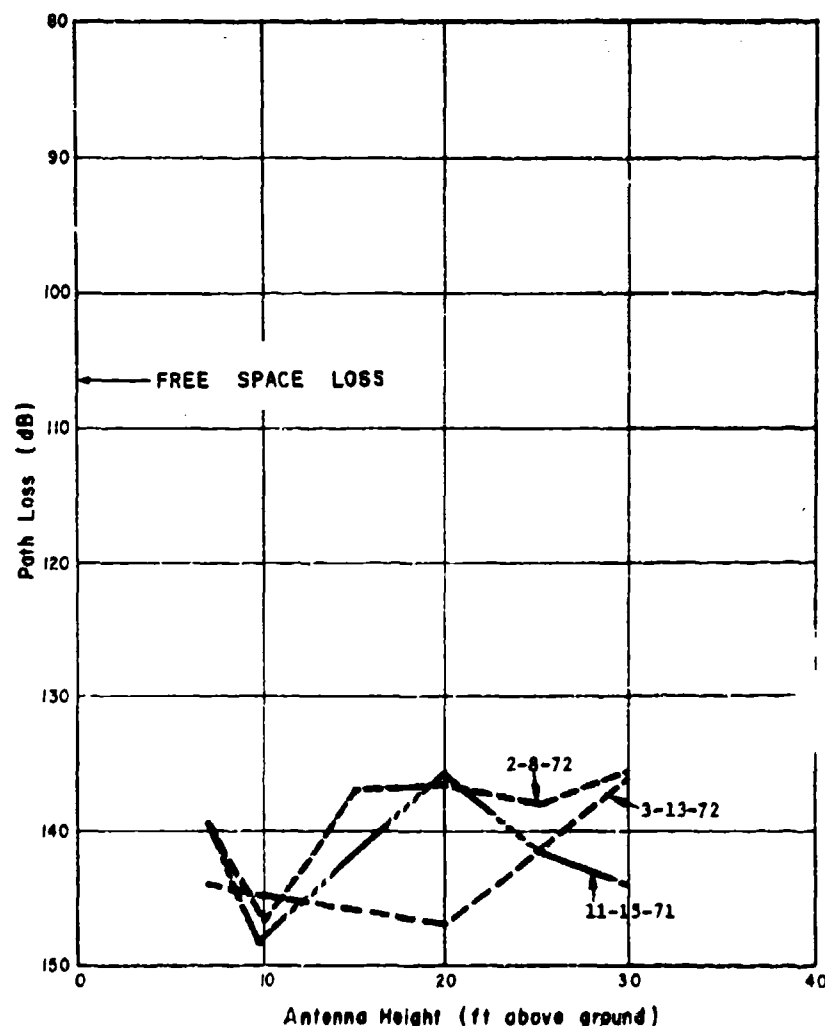


Figure 46. Propagation Path Loss (Site 19 to Hexagon, Frequency 1,345 MHz, Antenna - AEL Horn)

(6) Path: Highlands Site No. 21 to ECOM Hexagon.

Oper. Freq. 1,545 MHz Ant. Type - See Graph

Site description: See subparagraph b (7) above.

31 Jan. 72 - ----- AEL Horn

31 Jan. 72 - ————— Andrews Discone - 1-1/2 inches of snow on ground and melting

1 Feb. 72 - - - - - AEL Horn

Data spread does not exceed 2 dB.

Path loss never more than 6 dB below free space path loss.

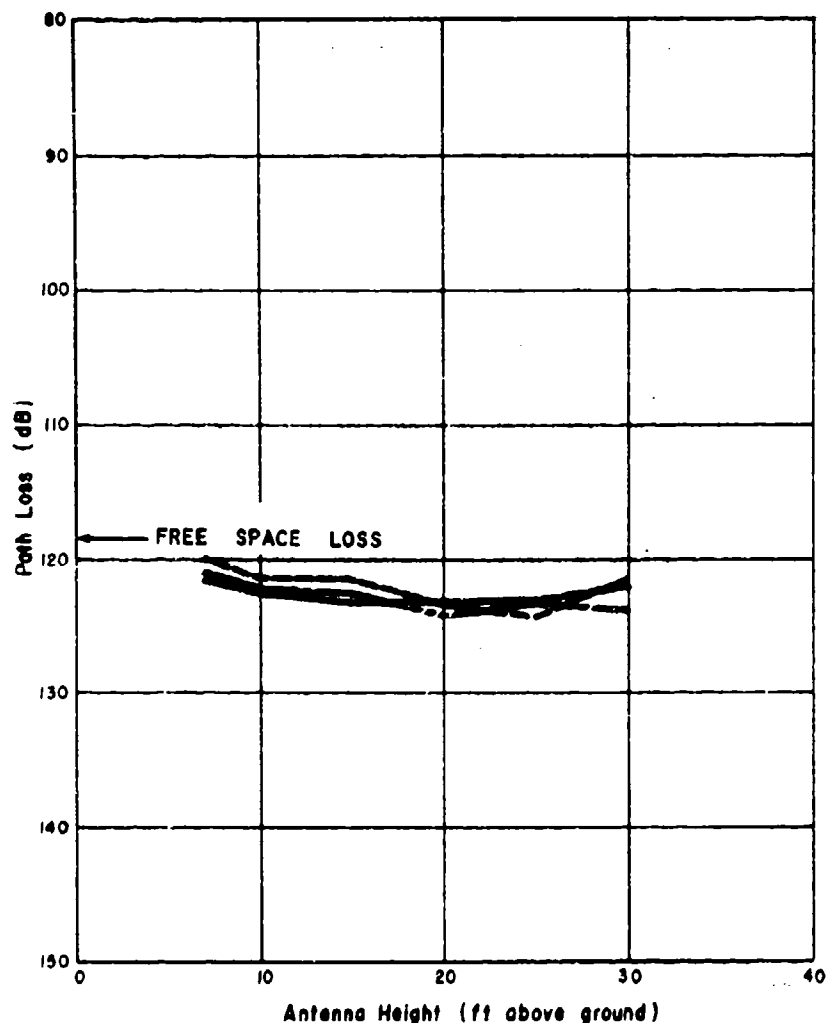


Figure 47. Propagation Path Loss (Site 21 to Hexagon, Frequency 1,545 MHz, Antenna (See Graph) )

(7) Path: Wavside Site No. 19B to ECOM Hexagon - 1.86 miles.

Oper. Freq. 1,545 MHz

Three additional plots are included to provide data for the composite plot for comparing the performance when signals are transmitted in horizontal, vertical, and circular polarisation modes.

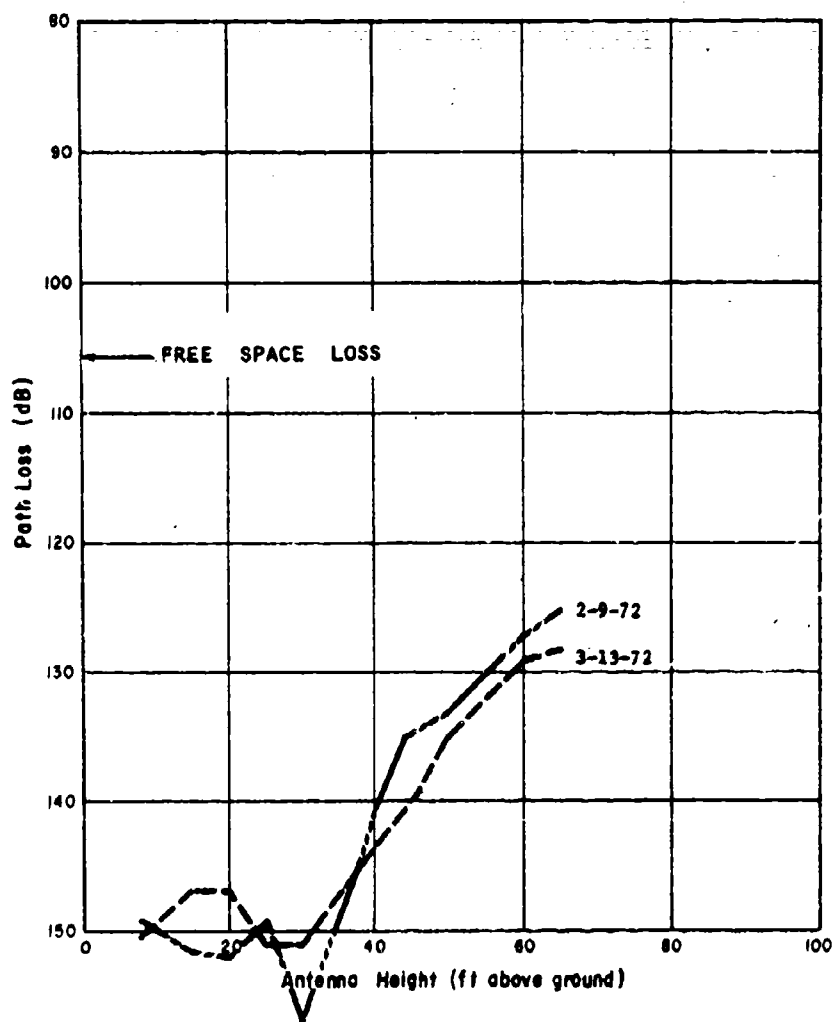


Figure 48. Propagation Path Loss (Site 19B to Hexagon, Frequency 1,545 MHz, Antenna - AEL Horn (Horizontal))

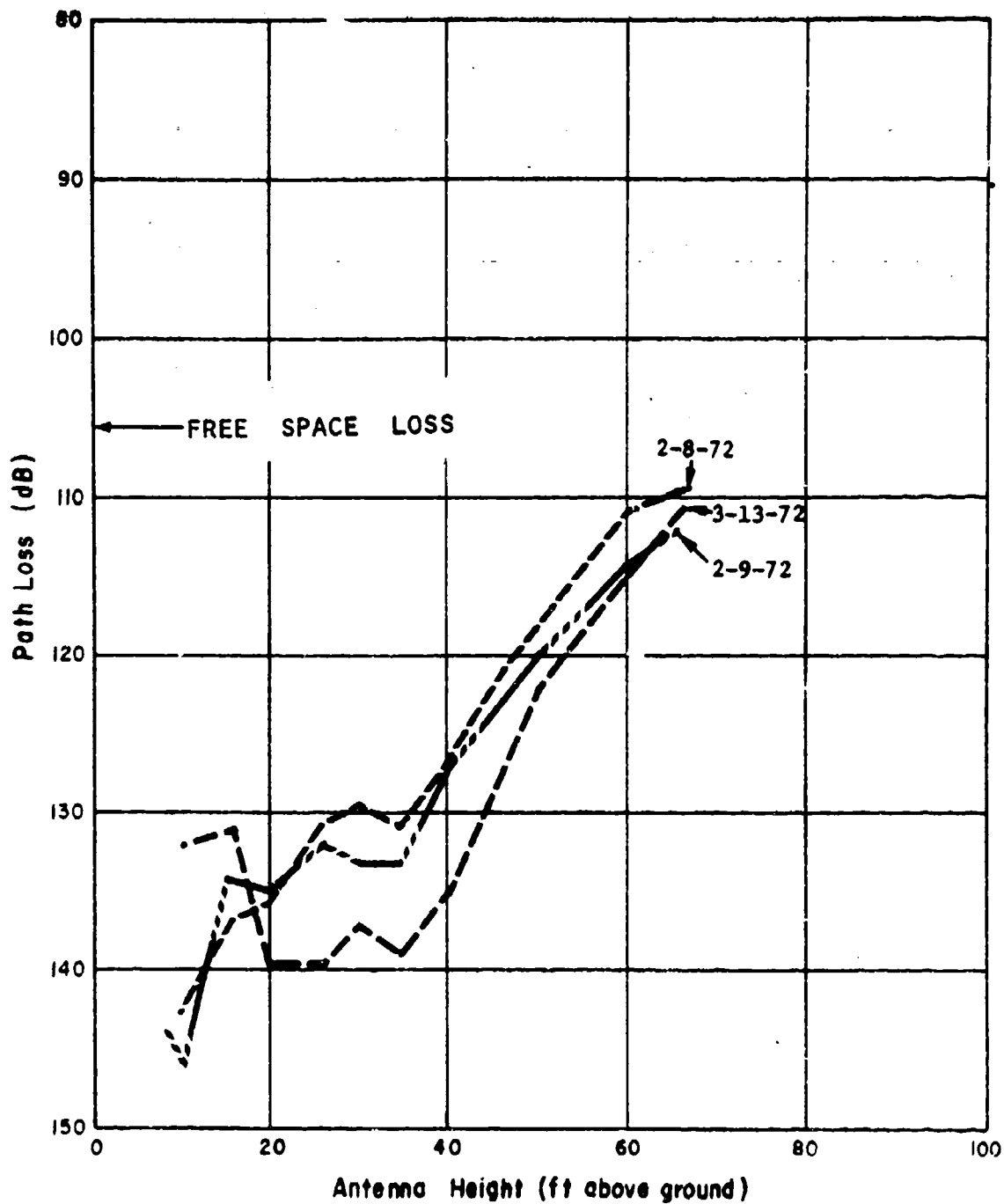


Figure 49. Propagation Path Loss (Site 19B to Hexagon, Frequency 1,545 MHz, Antenna - AEL Horn (Vertical))

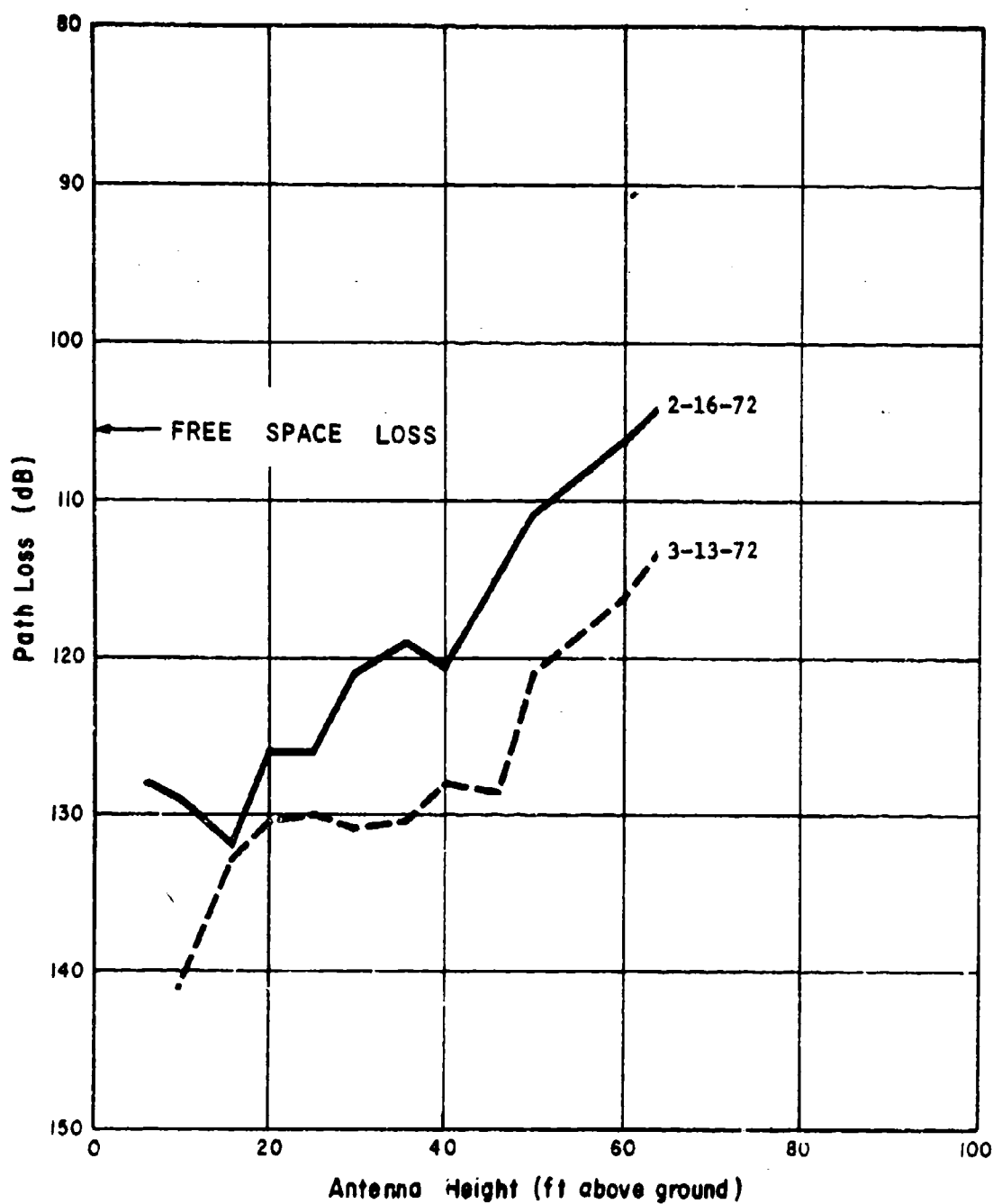


Figure 50. Propagation Path Loss (Site 19B to Hexagon, Frequency 1,545 MHz, Antenna - EMCO 3102 (Circular))



(B) Path: Wyeida Site No. 128 to ECOM Hexagon - 1.06 miles.

Oper. Freq. 1,345 MHz Ant. Type (See Graph)

The advantages of circular polarisation demonstrated on this path for 229.5 and 371.4 MHz are similar at 1,345 MHz. At 1,345 MHz, performance with the AEL Horn antenna in vertical polarisation is 6 to 9 dB below that with the circularly polarised EMEC Model 3102 log spiral antenna for antenna heights above 10 feet. The path loss when using the AEL Horn in horizontal polarisation is from 8 to 20 dB more than with vertical polarisation.

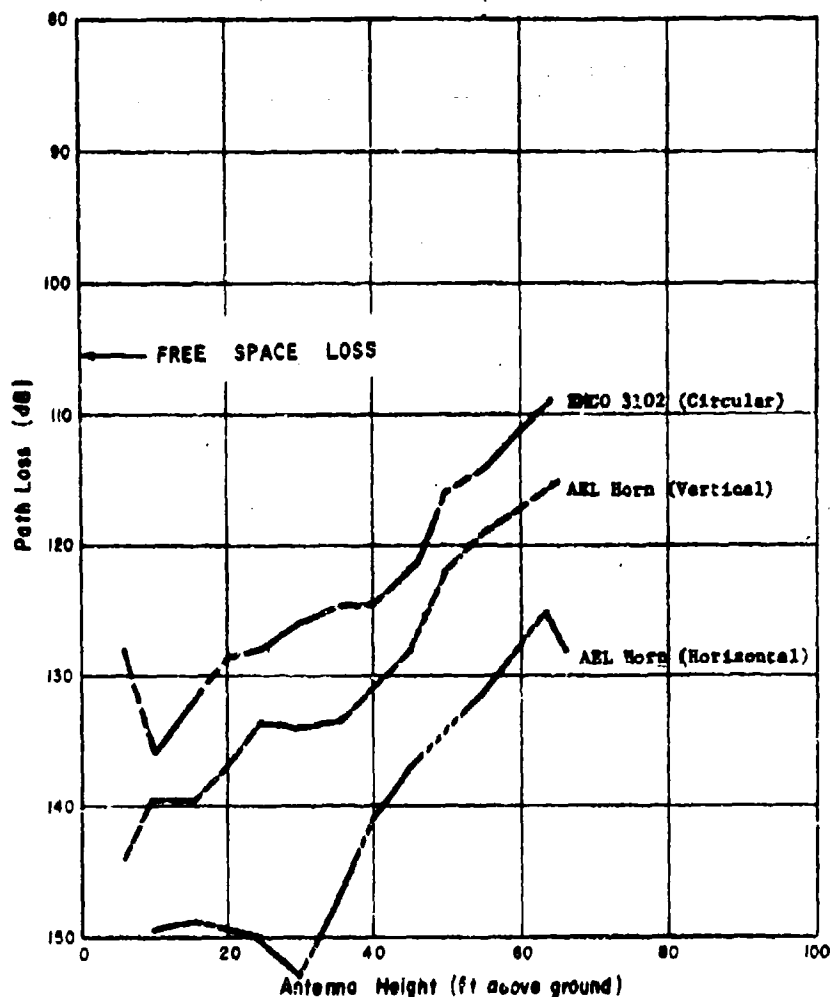


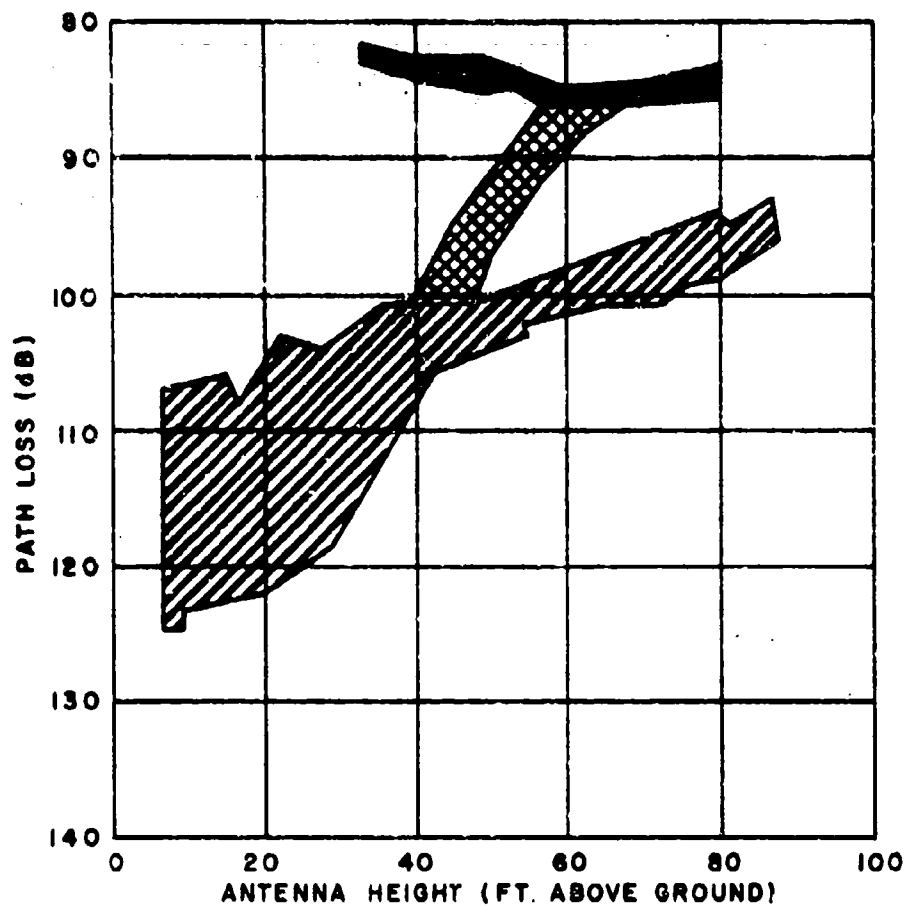
Figure 31. Propagation Path Loss (Site 128 to Hexagon, Frequency 1,345 MHz, Antenna (See Graph) )

## 9. COMMENTS ON THE TEST RESULTS

The path loss tests were conducted in the vicinity of the Hexagon Building, Fort Monmouth, and within a radius of less than 10 miles from it. Propagation paths varied from line of sight to completely out of line of sight, through trees and brush. The maximum losses at 1,545 MHz were approximately 150 dB, and it was possible to receive the signal from all sites. At 229.5 and 371.4 MHz, the maximum losses were close to 135 dB under the same conditions.

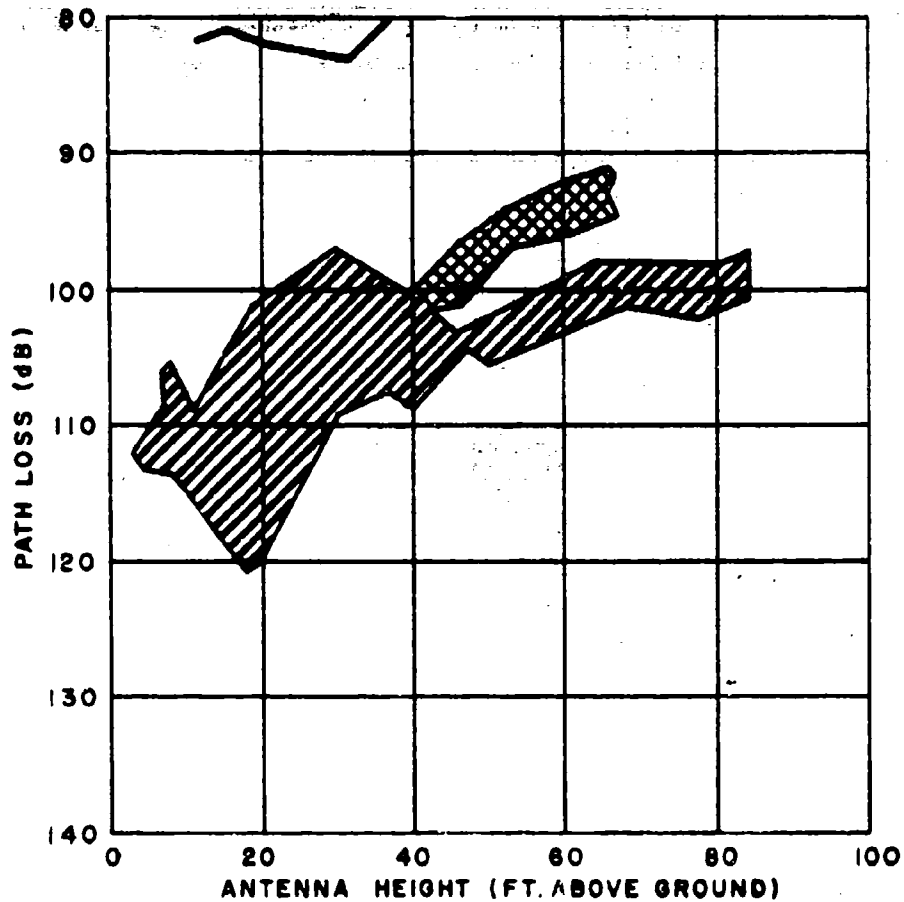
The test included experiments with vertically polarized, horizontally polarized, and circularly polarized antennas. The results indicated that there is some signal depolarization, probably due to the obstructions in the signal path.

The free space loss for any path length can be calculated from the expression -  $Loss = 36.58 + 20 \log_{10} d + 20 \log_{10} f$ , where  $d$  is in statute miles and  $f$  in MHz. To determine the path loss which is due to physical factors in the path other than free space loss, the free space loss is subtracted from the total loss. This was done for all tests covered in this report and the results plotted in Figures 52, 53, and 54 for 1,545, 371.4, and 229.5 MHz respectively. These plots show the range of path losses, in addition to the free space path losses, which we observed, as a function of antenna height, independent of distance between the transmitter and receiver, but within our less than 10-mile radius test area. The plots contain areas which are striped, crosshatched, and solid. The solid areas are the results of data obtained where there was definitely clear line of sight between the transmitting and receiving antennas. The striped areas are based on data obtained from paths where there was definitely no line of sight. The crosshatched areas are based upon results where there was marginal line of sight. Obviously, although the plot shows a clear border between these areas, these borders are only approximate and cannot be that sharply defined. These plots, however, do show the maximum losses that we experienced in our area in addition to the free space loss. With them, one can estimate the antenna height required for a system of known gains, transmitter power, and receiver sensitivity, or conversely the required transmitter power if the other parameters are fixed.



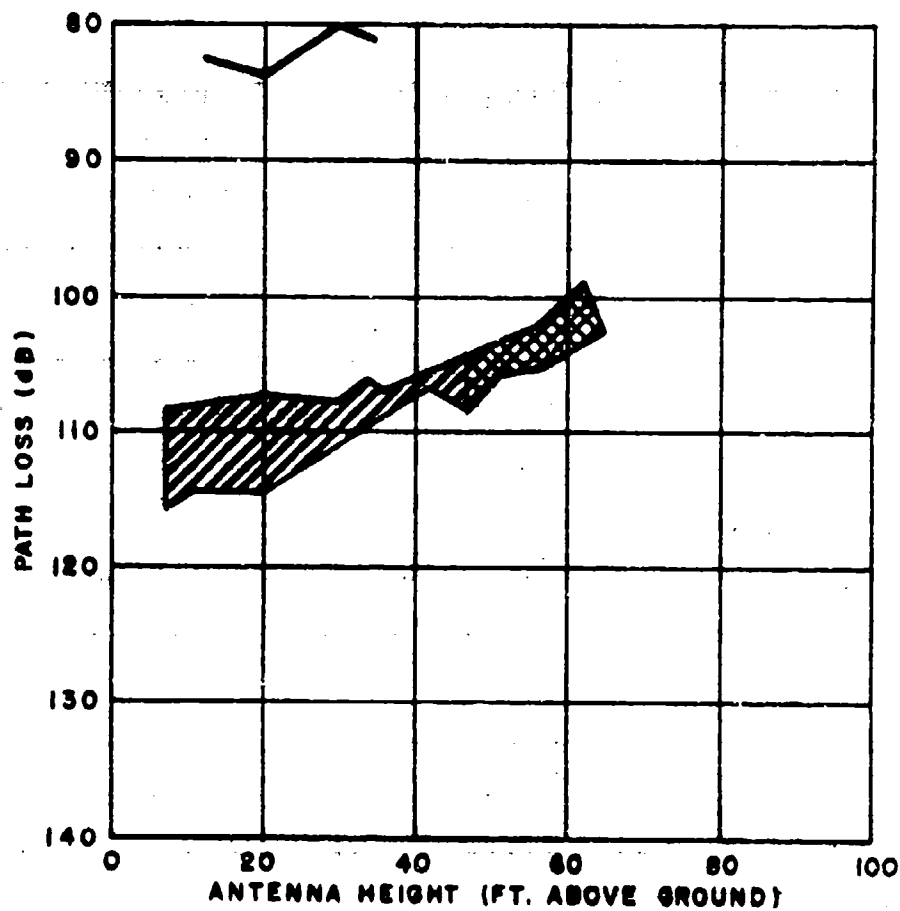
LOSS BELOW FREE SPACE LOSS  
 FREQ. 1545 MHz ANT. POLARIZATION VERTICAL

Figure 52. Propagation Path Loss - 1,545 MHz



LOSS BELOW FREE SPACE LOSS  
 FREQ. 371.4 MHz ANT. POLARIZATION VERTICAL

Figure 53. Propagation Path Loss - 371.4 MHz



LOSS BELOW FREE SPACE LOSS

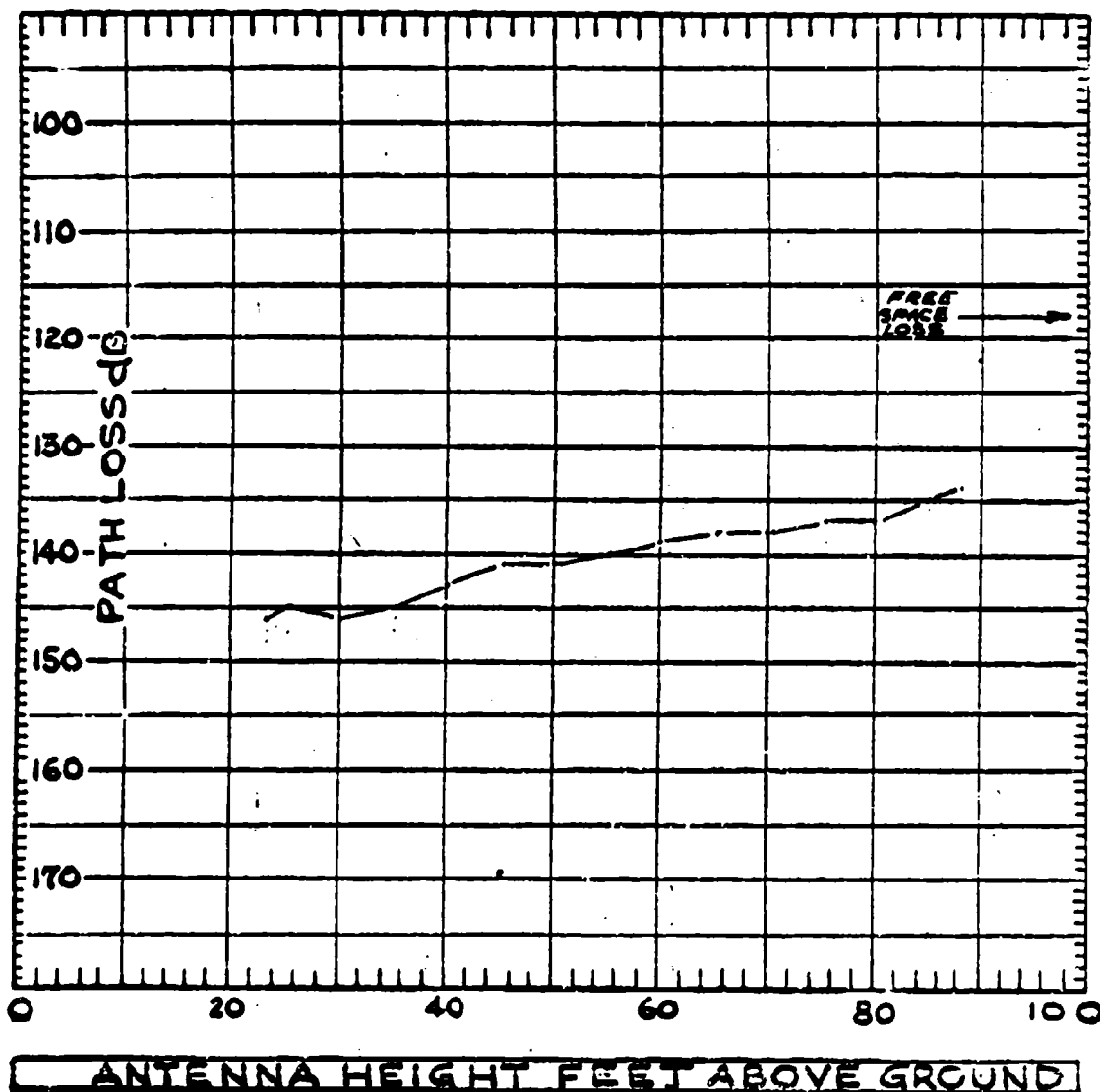
FREQ. 229.5 MHz ANT. POLARIZATION VERTICAL

Figure 54. Propagation Path Loss - 229.5 MHz

**APPENDIX**  
**REDUCED DATA**

TEST RUN #	AVERAGE PROPAGATION	24 JAN. 1972
120124-05	PATH LOSS AEL MCA SITE	
	NO. 5 TO LCOM HEXAGON	

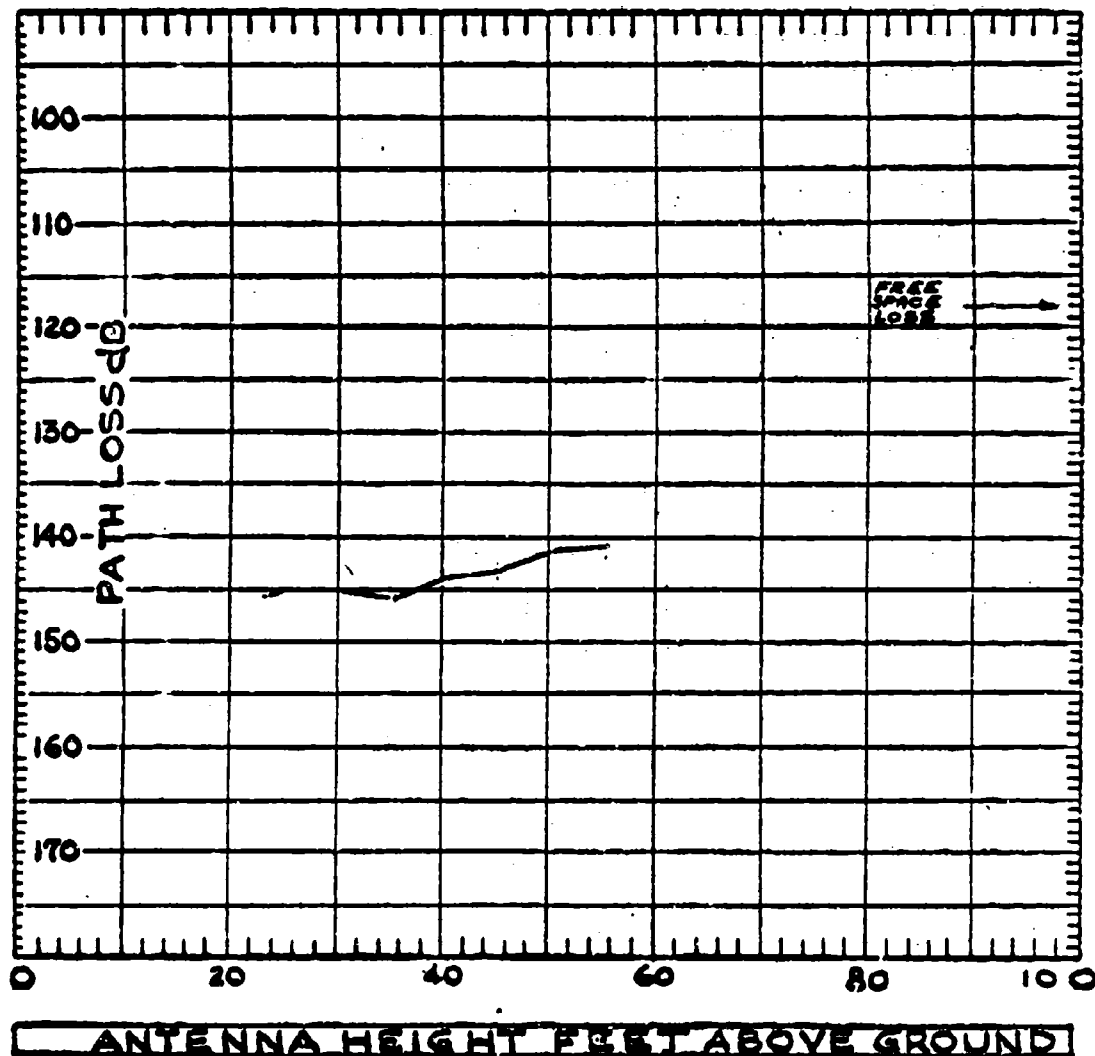
**FREQUENCY: 1545 MHZ**



TEST DATA SHEET									
OPER. FREQ.		1545 MHz		REC. SITE ANT. HT.		FT.		DATE: 24 JANUARY 72	
				START:				MRS.	
SITE		LOCATION	XMITR PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)		
TRANSMITTER		ALL MCA No. 5	44 dBm	REL 1/ORN	14.4	6.5	XMITR. PWR. 44		
RECEIVER		ECOM HEXAGON		ANALOG BICONICAL	0.3	HELION 1.2	+ANT. GAINS 19.7		
TOTAL ANT. GAIN (XMITR + REC.)		14.4 + 0.3 = 14.7 db							
TOT'L CABLE LOSS (XMITR + REC.)		6.5 + 1.2 = 7.7 db							
XMITR. SITE HEIGHT ABOVE SEA LEVEL		155 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		145 FT.			
XMITR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dbm)		PATH LOSS (db) - (RCVD. PWR.)		AVG. PATH. LOSS (db)	NO. OF SAMP	REMARKS		
	TEST	TEST	(ESP)	(db)					
88	720124-03		720124-03		134	1			
85	83		134		135				
80	84		135		137				
75	86		137		137				
70	87		138		138				
65	87		138		138				
60	88		139		139				
55	89		140		140				
50	90		141		141				
45	90		141		141				
40	92		143		143				
35	94		145		145				
30	95		146		146				
25	94		145		145				
23	95		146		146				

TEST RUN 574	AVERAGE PROPAGATION	25 JAN 1972
420125-01	PATH LOSS ALL MCA SITES	
	NO 2 TO ECOM HANSON	

FREQUENCY: 1548 MHz

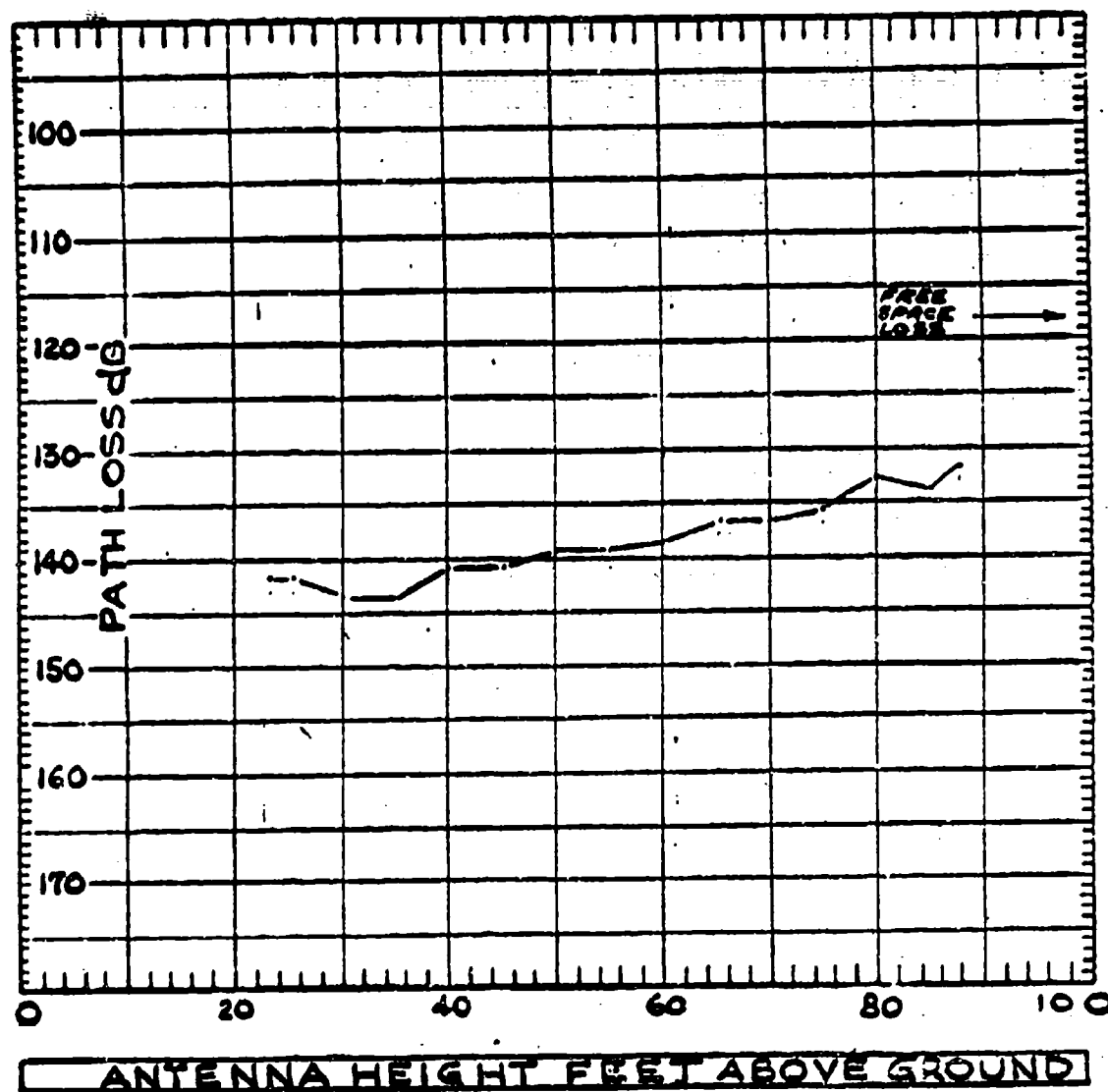






TEST RUN BY	AVERAGE PROPAGATION	25 JAN 1972
720126-01	PATH LOSS AVE MCA SITE	
	NOA TO ECOM HERABON	

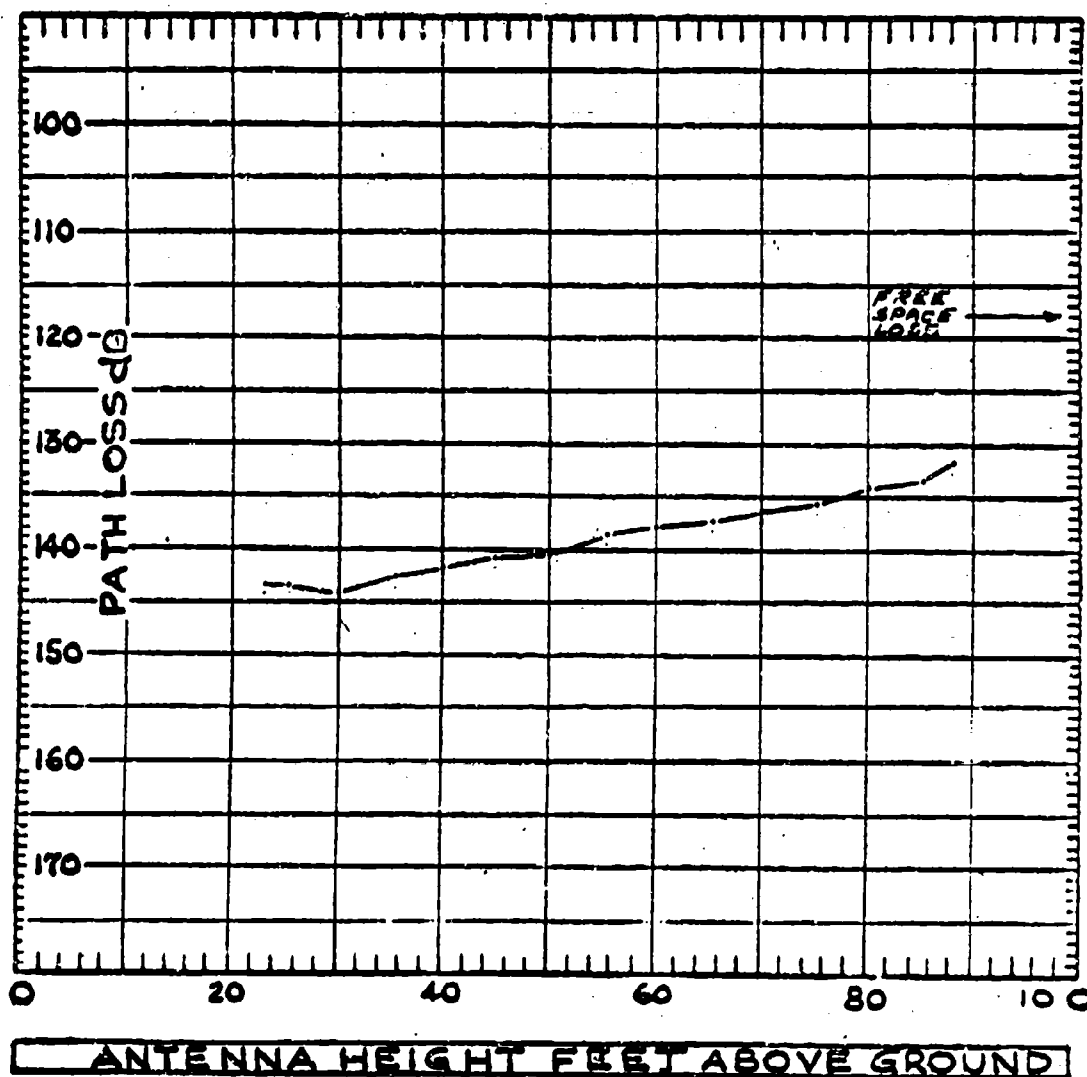
FREQUENCY 1545 MHz



TEST DATA SHEET									
OPER. FREQ.		1545 MHZ		REC. SITE ANT. HT.		FT.		DATE: 26 JANUARY 1972	
START: 1407 HRS.									
SITE	LOCATION	XMITR	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)			
TRANSMITTER	AEL MCA #5	44-1B1	AEL HORN	14.4	5.3	XMITR. PWR. 44			
RECEIVER	ECOM HEXAGON		ANDREW ALCONICAL	0.3	1.2	ANT. GAINS 14.7			
TOTAL ANT. GAIN (XMITR + REC.)		14.4 + 0.3 = 14.7 dB							
TOTAL CABLE LOSS (XMITR + REC.)		5.3 + 1.2 = 6.5 dB							
XMITR. SITE HEIGHT ABOVE SEA LEVEL		155 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		145 FT.			
XMITR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)	TEST		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMPL	REMARKS	
88	720126.01			720126.01		132	1		
85	80			132		134			
80	82			134		133			
75	81			133		136			
70	84			136		137			
65	85			137		137			
60	85			137		138			
55	87			139		140			
50	88			140		140			
45	88			141		141			
40	89			141		141			
35	92			144		144			
30	92			144		144			
25	90			142		142			
23	90			142		142			

TEST RUN 5/N	AVERAGE PROPAGATION	27 JAN 1972
76127-01, 02	PATH LOSS AEL MCA SITE	
03 AND 04	NO 5 TO ECOM HEXAGON	

FREQUENCY: 134.5 MHz

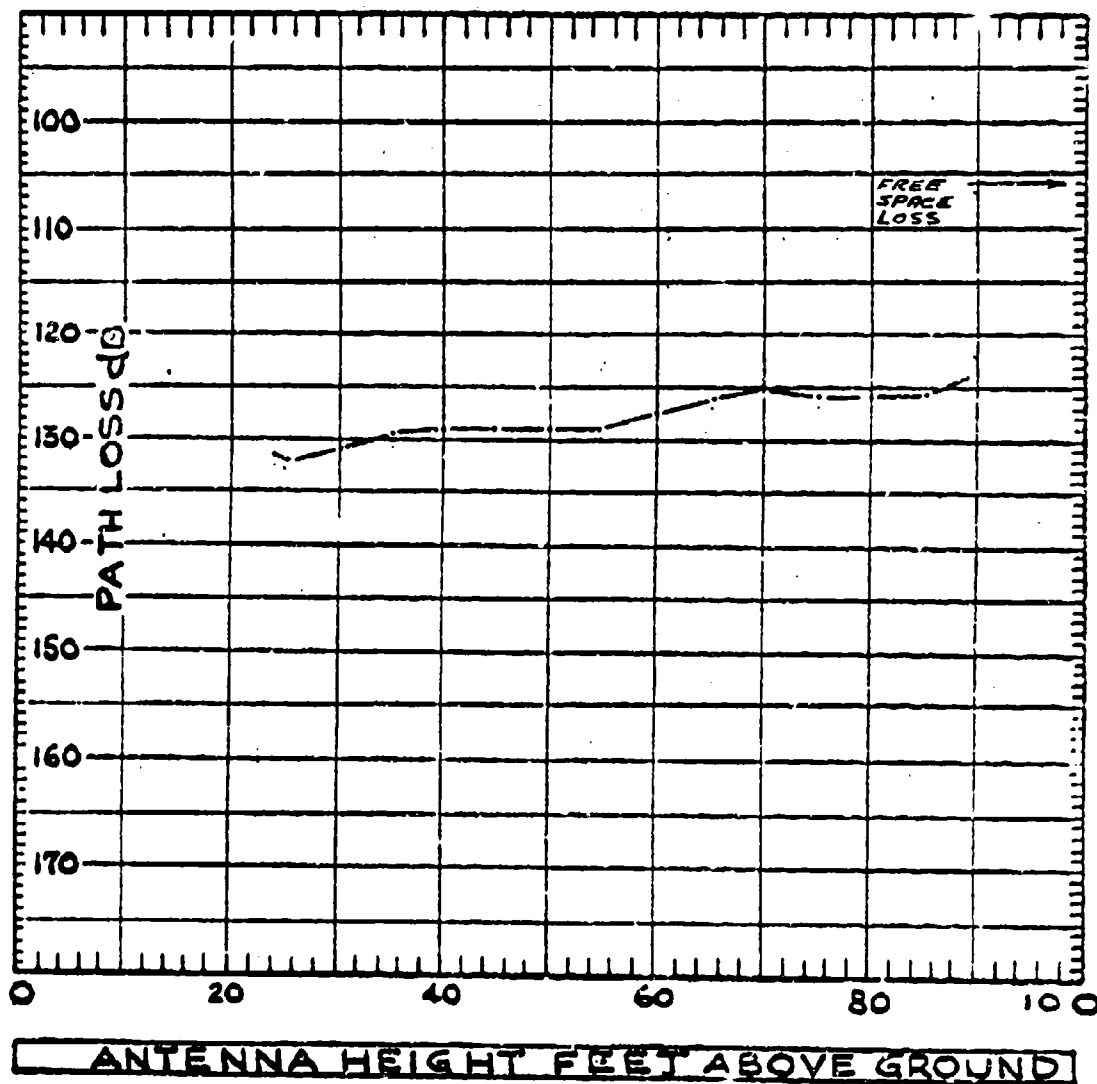


TEST DATA SHEET											
OPER. FREQ.		1545 MHz		REC. SITE ANT. HT.		FT.		DATE: 27 JANUARY 72		START: 09:00 HRS.	
SITE	LOCATION	XMTX PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)					
TRANSMITTER	DEL MCA 5	44 dBm	REL 160N	14.4	5.3	XMTX PWR. 14.1					
RECEIVER	LCOM Hexagon		ANDREW BICONICAL	0.3	1.2	+ANT. GAINS 14.7					
TOTAL ANT. GAIN (XMTX + REC.)		14.4 + 0.3 =		14.7 dB							
TOTAL CABLE LOSS (XMTX + REC.)		5.3 +		1.2 =		6.5 dB		-ESP = 12.2 USE 52			
XMTX. SITE HEIGHT ABOVE SEA LEVEL		135 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		145 FT.					
XMTX. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS				
	TEST	TEST	720127-01	720127-02				720127-03			
23	90	92	142	144	144	4	END 720127-01	1015			
25	90	92	142	144	144	1	START 720127-02	1045			
30	90	93	142	145	145		END 720127-02	1120			
35	89	91	141	143	144		START 720127-03	1340			
40	89	90	141	142	142		END 720127-03	1407			
45	88	89	140	141	141		AVG. PATH LOSS (dB) INCLUDES TEST RUN 5/N 720127-01 720127-02 720127-03				
50	87	89	139	141	141						
55	87	87	139	139	139						
60	85	87	137	139	138						
65	85	86	137	138	138						
70	83	85	135	137	137						
75	82	84	134	136	136						
80	81	82	133	134	134						
85	81	81	133	133	134						
88	79	80	131	132	132	4					



TEST RUN 5/N	AVERAGE PROPAGATION	27 JAN 1972
720127-05	PATH LOSS AEL MEASUREMENT	
720127-06	NO 5 TO ECOM HEXAGON	

FREQUENCY: 371.4 MHz

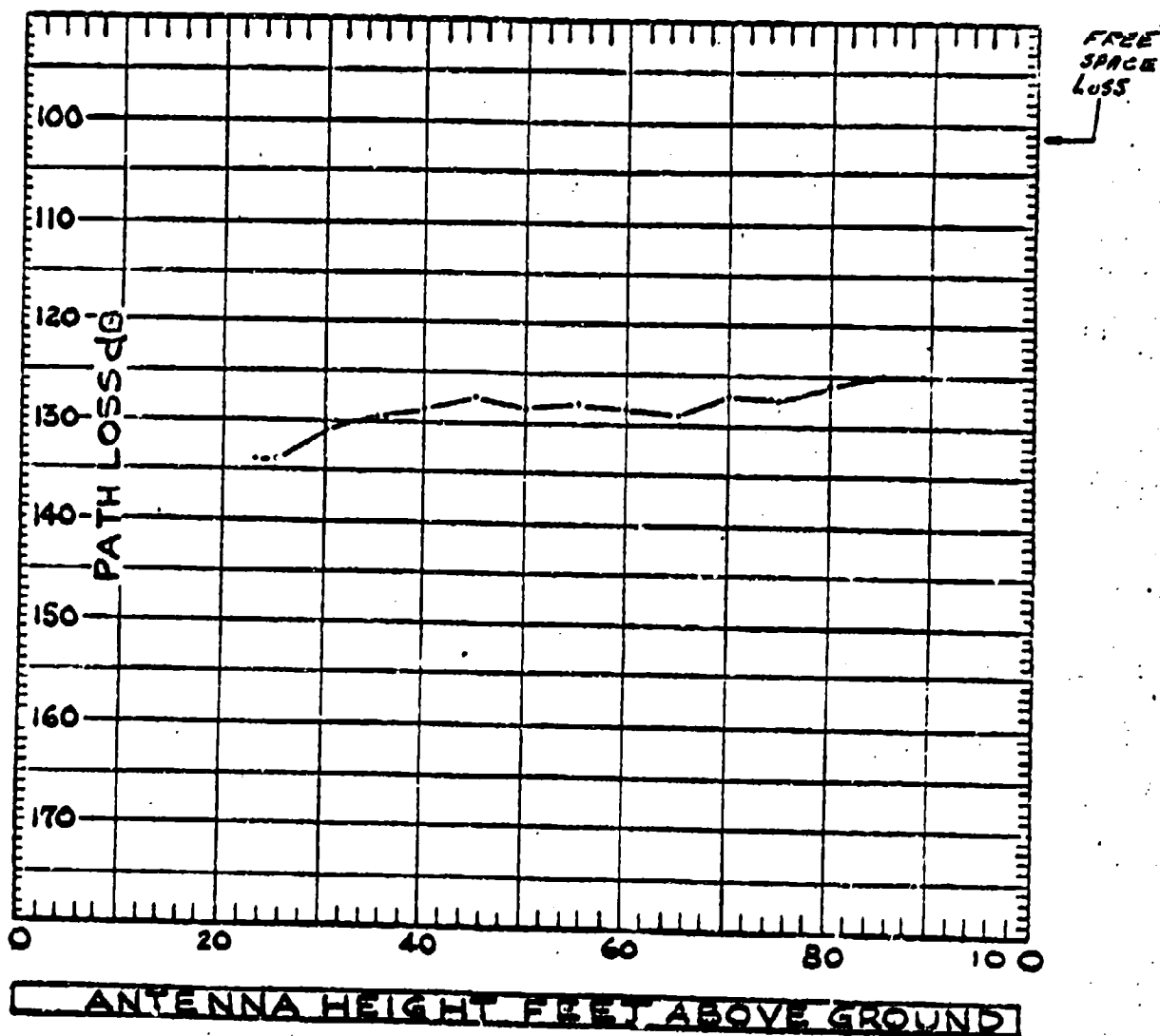






TEST RUN 3/N	AVERAGE PROPAGATION	28 JAN 1972
720128-05	PATH LOSS AEL MEASURES	
	TO ECOM HERAGON	

FREQUENCY: 229.5 MHZ

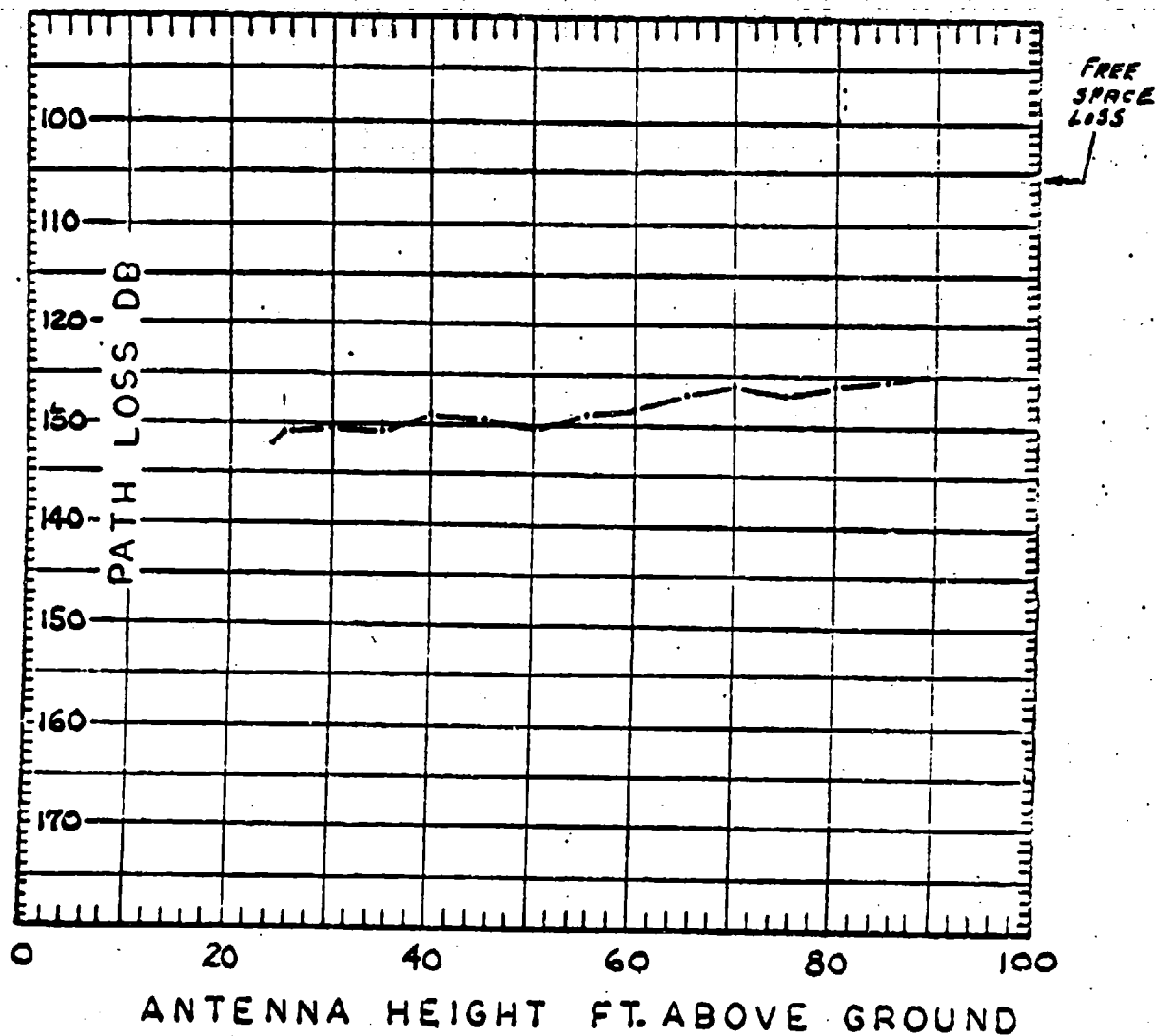


TEST DATA SHEET									
OPER. FREQ.		229.5 MHz		REC. SITE ANT. HT.		FT.		DATE: 28 JANUARY 72	
				REC. SITE ANT. HT.		FT.		START: 1437 HRS.	
SITE		LOCATION		XMTR. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)	
TRANSMITTER		DEL MCA 5		44 dBm	AT 197	1.2	2.5	XMTR. PWR. 4.1	
RECEIVER		ECOM HELIXAGON			AT 197	1.2	1.8	+ANT. GAINS 2.4	
TOTAL ANT. GAIN (XMTR + REC.)		1.2 + 1.2 = 2.4				dB		-CABLE LOSSES 1.2	
TOTAL CABLE LOSS (XMTR + REC.)		2.5 + 1.8 = 4.3				dB		-ESP = 41.9	42
XMTR. SITE HEIGHT ABOVE SEA LEVEL		155		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140 FT.	
XMTR. ANT. HT. ABOVE GND (FT)		RCVD. PWR. (dBm)		TEST	TEST	PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMPL
23	92	720128-03				720128-03		134.0	2
25	92					134		134.0	2
30	89					131		131.0	2
35	88					130		129.5	2
40	87					129		128.5	2
45	86					128		127.5	2
50	87					129		128.5	2
55	87					129		128.0	2
60	87					129		128.5	2
65	87					129		129.0	2
70	85					127		127.0	2
75	85					127		127.5	2
80	84					126		126.0	2
85	83					125		125.0	2
89	83					125		125.0	1
85	83					125			
80	84					126			
75	86					128			
70	85					127			
65	87					129			



PROPAGATION PATH LOSS  
DATE: 28 JANUARY 72 TEST RUN S/N: 720128-01  
PATH: AEL MCA SITE NO. 5 TO ECOM HEXAGON

OPER. FREQ.: 371.4 MHz

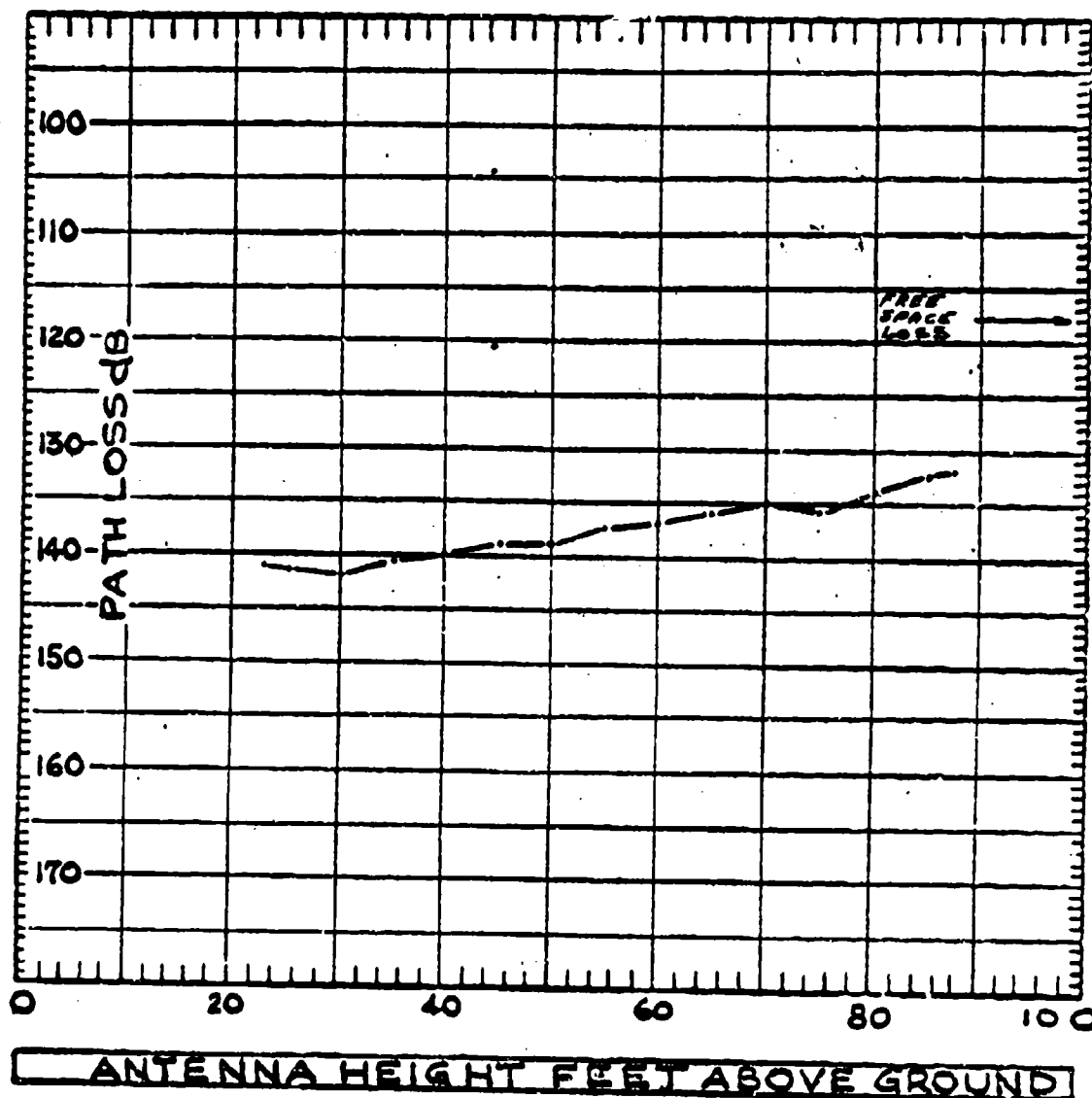


TEST DATA SHEET									
OPER. FREQ.		371.4 MHZ		REC. SITE ANT. HT.		FT.		DATE: 28 JANUARY 1972	
				ANT. GAIN (dB)		CABLE LOSSES (dB)		EQUIV. SYS. PWR. (ESP)	
TRANSMITTER		AEL MCA 5		AT197		2.0		44	
RECEIVER		ECOM HEXAGON		AT197		2.0		4.0	
TOTAL ANT. GAIN (XMT + REC.)		2.0 + 2.0 = 4.0		dB				- CABLE LOSSES 4.0 ✓	
TOTAL CABLE LOSS (XMT + REC.)		2.2 + 2.3 = 4.5		dB				PSP - 43.5 USE 44	
XMT. SITE HEIGHT ABOVE SEA LEVEL		155		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140 FT.	
XMT. ANT. NO. ABOVE GND (FT)	RCVD. TEST	PWR. (dBm)	TEST	PATH LOSS (dB) = (ESP) - (RCVD. PWR.)	AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS		
24	88		72.0, 128.01	132	132	2	WIND CALM - 1 KT.		
25	87			131	131	1			
30	86			130	130.5		SOME ICE FORMATION ON ANTENNA		
35	87			131	131				
40	84			128	129				
45	85			129	129.5				
50	86			130	130.5				
55	85			129	129.0				
60	85			129	128.5				
65	83			127	127.0				
70	82			126	126.0				
75	82			126	127.0	1			
80	81			125	126.0				
85	82			126	125.5	2			
89	81			125	125.0	1			
85	81			125					
80	83			127					
75	84			128					
70	82			126					
65	83			127					



TEST RUN 5/N	AVERAGE PROPAGATION	28 JAN 1972
720128-02	PATH LOSS ABL RFA SITE	
	NO. 2 TO 120M HIRAKON	

FREQUENCY: 1545 MHZ



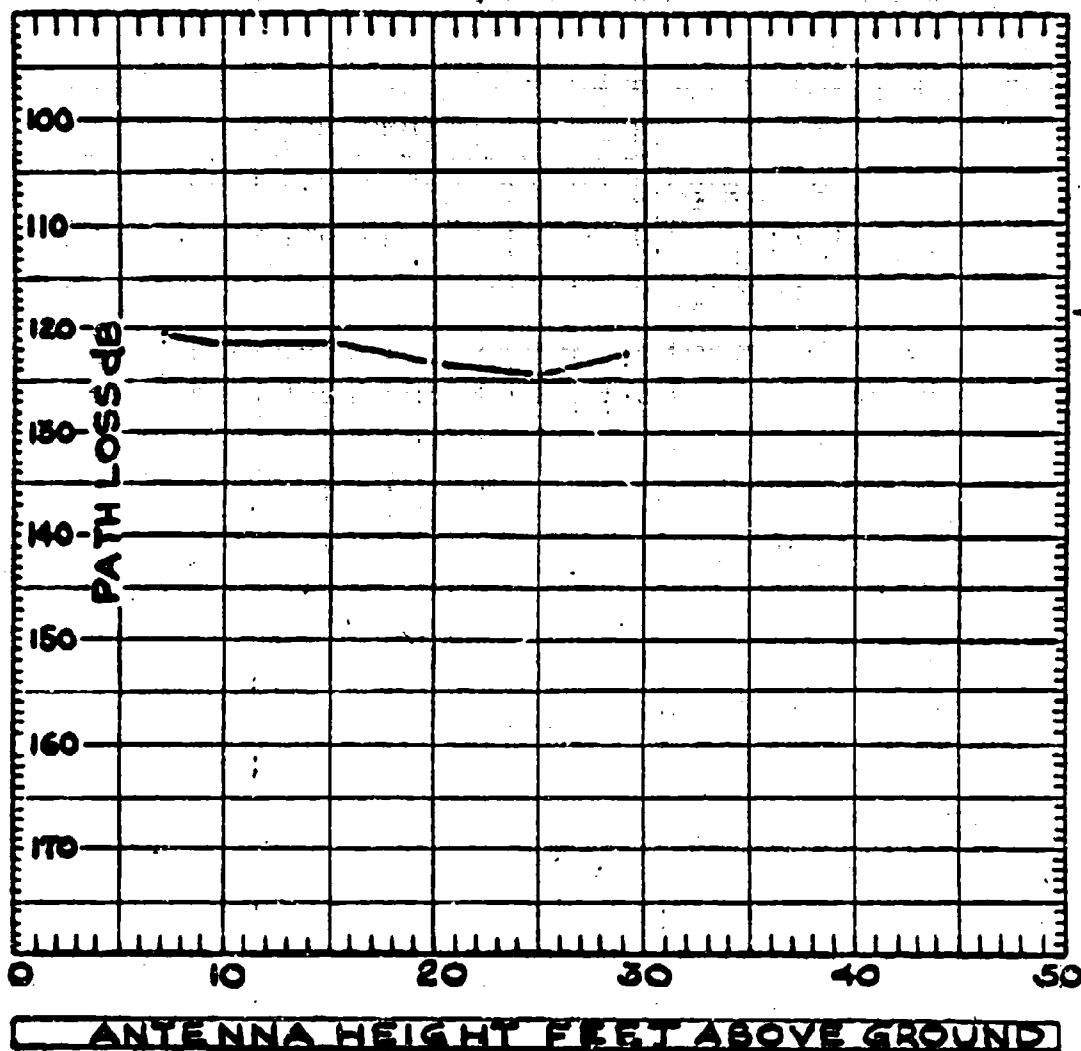
TEST DATA SHEET									
OPER. FREQ.		1545 MHz		DATE: 28 JANUARY 72		REC. SITE ANT. HT.		FT.	
SITE		LOCATION		XMT. PWR.		TYPE ANTENNA		ANT. GAIN (dB)	
TRANSMITTER		AEL MCA 5		44 dBm		REL HORN		14.4	
RECEIVER		ECOM HEXAGON		[REDACTED]		ANDREW BICONICAL		0.3	
TOTAL ANT. GAIN (XMT + REC.)		14.4 + 0.3 = 14.7		dB				CABLE LOSSES (dB)	
TOTAL CABLE LOSS (XMT + REC.)		7.9 + 1.2 = 9.1		dB				EQUIV. SYS. PWR. (ESP)	
XMT. SITE HEIGHT ABOVE SEA LEVEL		155		FT.				XMT. PWR. 44	
RCVD. PWR. (dBm)		TEST		TEST		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	
XMT. ANT. HT. ABOVE GND (FT)		720128-02		720128-02				NO. OF SAMP	
23	91				141		141.0	2	WIND CALM 270° 1KT
25	91				141		141.0	1	TEMP. 27° F
30	92				142		142.0		2.5 IN. SNOW ON GROUND
35	90				140		140.0		
40	90				140		140.0		
45	89				139		139.0		
50	89				139		139.0		
55	87				137		137.0		
60	87				137		137.0		
65	86				136		136.0		
70	85				135		135.0		
75	84				134		134.0		
80	84				134		134.0		
85	82				132		132.0	2	
88	82				132		132.0	1	
85	83				133				
80	84				134				
75	85				135				
70	85				135				
65	86				136				



TEST DATA SHEET									
OPER. FREQ.		1545 MHz		REC. SITE ANT. HT.		FT.		DATE: 28 JANUARY 72	
								START: 1315 HRS.	
SITE	LOCATION	XMTTR PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)			
TRANSMITTER	AEL MCA 5	44 dBm	AEL HORN	14.4	7.9	XMTTR. PWR.	4.4		
RECEIVER	ECUM HEXAGON		ANDREW BICORNERAL	0.3	1.2	+ANT. GAINS	14.7		
TOTAL ANT. GAIN (XMTTR + REC.)		14.4 + 0.3 = 14.7		dB		-CABLE LOSSES	9.1		
TOTAL CABLE LOSS (XMTTR + REC.)		7.9 + 1.2 = 9.1		dB		-ESP = 49.6 USE 50			
XMTTR. SITE HEIGHT ABOVE SEA LEVEL		155		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		145	
XMTTR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)	PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS			
720128-02	TEST TEST	720128-02							
60	87	137							
55	88	138							
50	89	139							
45	89	139							
40	90	140							
35	91	141							
30	92	142							
25	92	142							
23	91	141				END 720128-02 1345			

TEST RUN 5/N AVERAGE PROPAGATION	31 JAN 1972
WPT#1-01, 02 PATH LOSS SIGNAL ANTS	
AND 03. SITE NO. 2 TO ECU HEXAGON	

FREQUENCY: 1545 MHZ

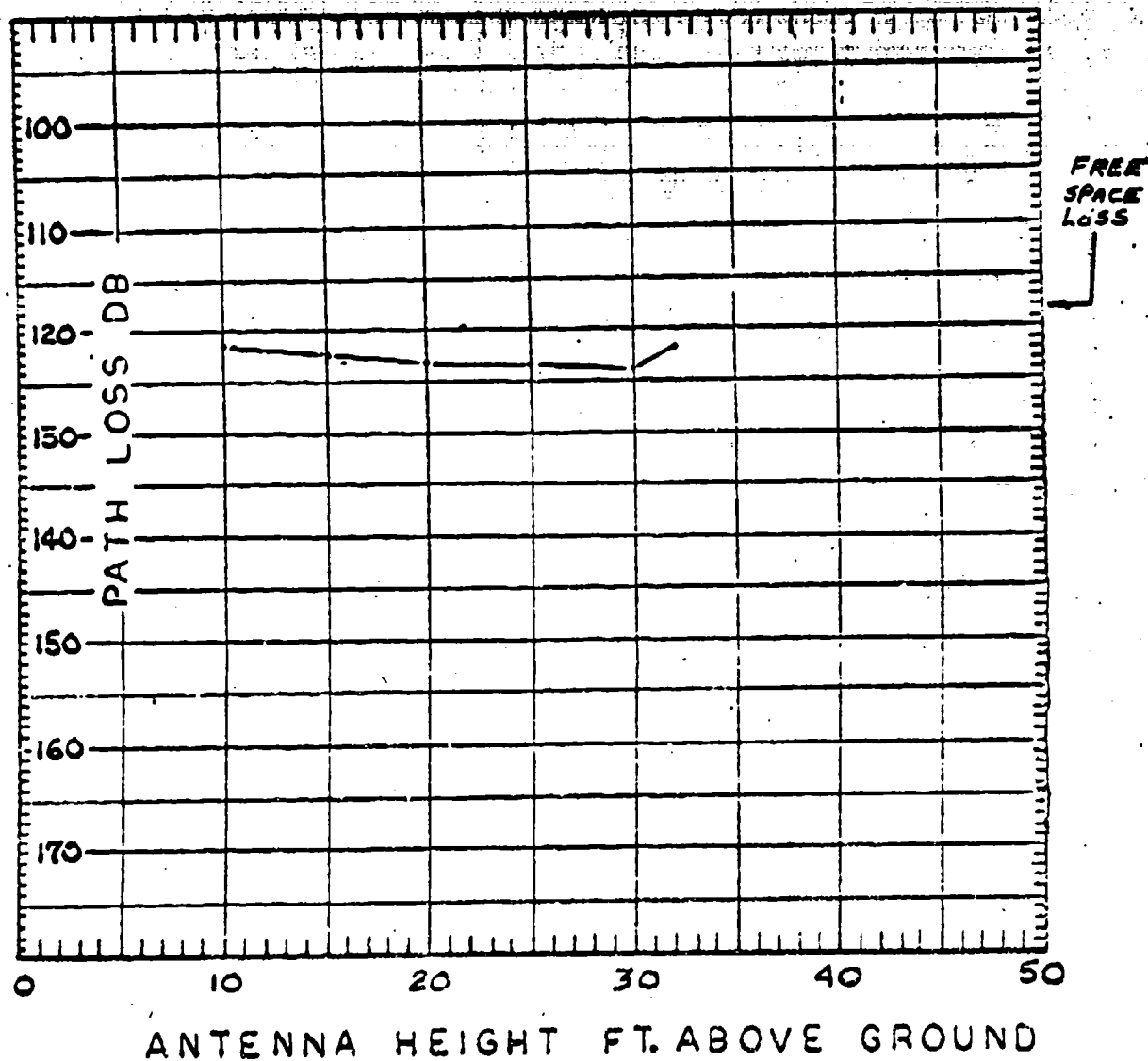


TEST DATA SHEET									
OPER. FREQ. 1545 MHz		DATE: 31 JANUARY 72		REC. SITE ANT. HT. FT.		START: 1350 HRS.			
SITE	LOCATION	XMITR. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)	XMITR. PWR.	ANT. GAINS	
TRANSMITTER	HIGHLANDS 21	44 dBm	AEI HORN	14.4	6.8		44		
RECEIVER	ECOM HEXAGON		ANDREW BICOGNAL	0.3	1.2			14.7	
TOTAL ANT. GAIN (XMITR + REC.)		14.4 + 0.3 =		14.7	dB			-TABLE LOSSES	8.0
TOTAL CABLE LOSS (XMITR + REC.)		6.8 + 1.2		8.0	dB			-ESP =	52.7 USE 51
XMITR. SITE HEIGHT ABOVE SEA LEVEL		200		FT.	RCVR. ANT. HEIGHT ABOVE SEA LEVEL		195		FT.
XMITR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMPS	REMARKS		
	TEST	TEST	720131-01	720131-02					
7	69	69	720131-01	720131-02	120.2	6	WIND 4 KTS - 1 KTS		
10	70	71	120	122	121.8	6	GUSTING TO 9 KTS		
15	69	70	120	121	121.3	6	TEMP. -1°C.		
20	72	71	123	123	123.7	6			
25	74	74	125	123	124.7	6			
29	71	71	122	123	122.3	3			
25	74	74	125	125					
20	72	73	123	124					
15	70	71	121	121					
10	71	71	122	122					
7	69	70	120	121			END 720131-01 - 1410		
							START 720131-02 - 1420		
							END 720131-02 - 1435		
							START 720131-03 - 1450		
							END 720131-03 - 1520		

# PROPAGATION PATH LOSS

DATE: 31 JANUARY 72 TEST RUN S/N: 720131-04905  
PATH: HIGHLANDS SITE NO. 21 TO ECOM HEXAGON

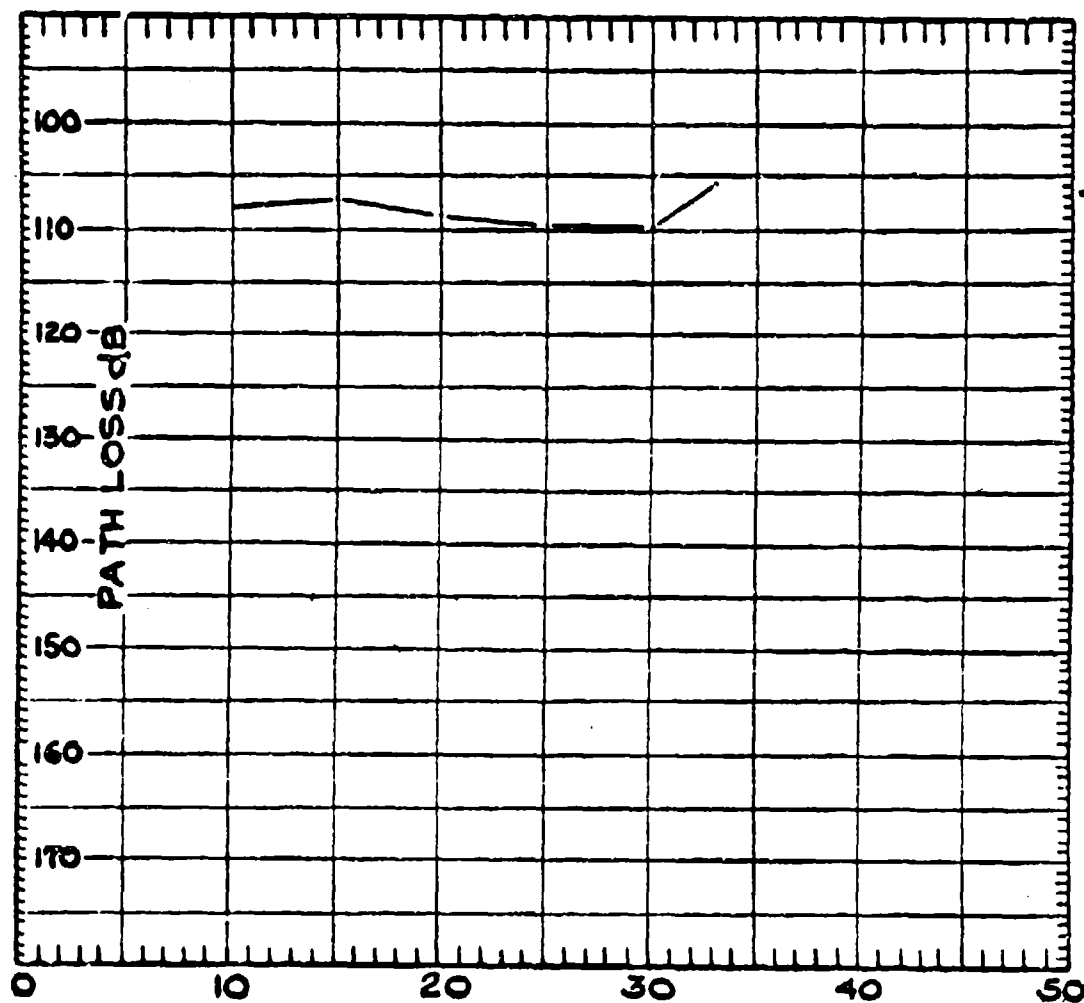
OPER. FREQ.: 1545 MHz



TEST DATA SHEET									
OPER. FREQ. 1545 MHz		DATE: 31 JANUARY 72		REC. SITE ANT. HT. FT.		START: 1520 HRS.			
SITE	LOCATION	XMT. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)			
TRANSMITTER	HIGHLANDS 21	44-1M	ANDREW'S DISCONE	2.5	6.8	44			
RECEIVER	ECON HANGON		ANDREW'S BICONICAL	0.3	1.2	2.8			
TOTAL ANT. GAIN (XMT + REC.)		2.5 + 0.3 = 2.8		dB					
TOTAL CABLE LOSS (XMT + REC.)		6.8 + 1.2 = 8.0		dB					
XMT. SITE HEIGHT ABOVE SEA LEVEL 200 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL 140 FT.							
XMT. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS		
	TEST	TEST	720131-04	720131-05					
10	81	83	120	122	121.5	4	WIND 2 KTS		
15	83	83	122	122	122.3	4	GUSTING TO 7 KTS		
20	84	84	123	123	123.3	4	1.5 IN. SNOW ON GROUND		
25	84	85	123	124	123.5	4			
30	84	86	123	125	123.8	4			
32	82	84	121	123	122.0	2			
30	84	85	123	124					
25	83	86	122	125					
20	84	85	123	124					
15	84	83	123	122					
10	81	81	120	120					
								END 720131-04 - 1535	
								START 720131-05 - 1544	
								END 720131-05 1600	

TEST RUN 6/N	AVERAGE PROPAGATION	FEB. 1972
720201-01	PATH LOSS HIGHLANDS	
-02 AND -03	SITE NO. 21 TO ECOM HERAGON	

FREQUENCY: 371.4 MHz

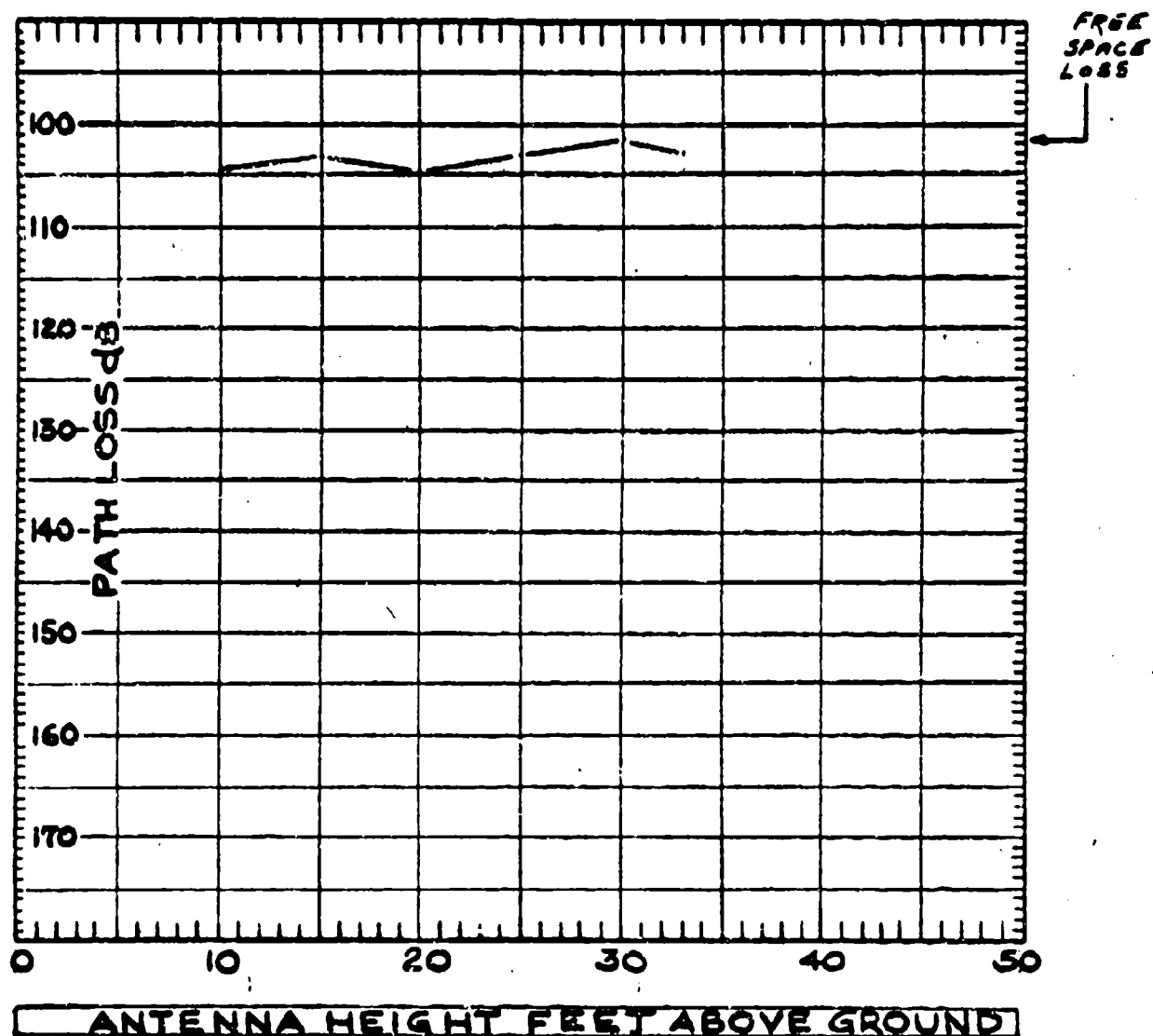


ANTENNA HEIGHT FEET ABOVE GROUND

TEST DATA SHEET											
OPER. FREQ.		371.4 MHz		DATE: 1 FEB. 1972		REC. SITE ANT. HT.		FT.		START: 0300 HRS.	
SITE	LOCATION	XMTR PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SVS. PWR. (ESP)					
TRANSMITTER	HIGHLANDS 21	44	AT-197	2.0	2.6	XMTR. PWR. 44					
RECEIVER	ECOM 11. XAG-11		AT-197	2.0	2.3	+ANT. GAINS 4.0					
TOTAL ANT. GAIN (XMTR + REC.)		2.0 + 2.0 = 4.0		dB		-CABLE LOSSES 4.9					
TOTAL CABLE LOSS (XMTR + REC.)		2.6 + 2.3 = 4.9		dB		-ESP = 43.1 USE 43					
XMTR. SITE HEIGHT ABOVE SEA LEVEL		200		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL	140		FT.		
XMTR. ANT. HT. ABOVE END (FT)	RCVD. PWR. (dBH)			PATH LOSS (dB) = (ESP) - (RCVD. PWR.)			AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS		
	TEST	TEST	TEST	720201-01	720201-02	720201-03					
10'3"	65	64	65	108	107	108	108	6	WIND 3 KTS. 240°		
15	64	64	64	107	107	107	107	6	GUSTING TO 4 KTS.		
20	65	65	66	108	108	109	108.5	6	TEMP. 26°F.		
25	66	67	67	109	110	110	109.5	6			
30	66	67	66	109	110	109	109.7	6			
32'7"	62	63	63	105	106	106	105.7	3			
30	66	69	66	109	112	109					
25	65	68	67	108	110	110					
20	65	67	65	108	110	108					
15	64	69	64	107	107	107					
10'3"	64	67	65	107	110	108			END 720201-01 - 1000		
									START 720201-02 1005		
									END 720201-02 - 1035		
									START 720201-03 - 1042		
									END 720201-03 - 1057		

TEST RUN S/N	AVERAGE PROPAGATION	FEB. 1972
720201-04	PATH LOSS HIGHLANDS	
AND 05	SITE NO. 2 TO ECOM HEXAGON	

FREQUENCY: 229.5 MHz

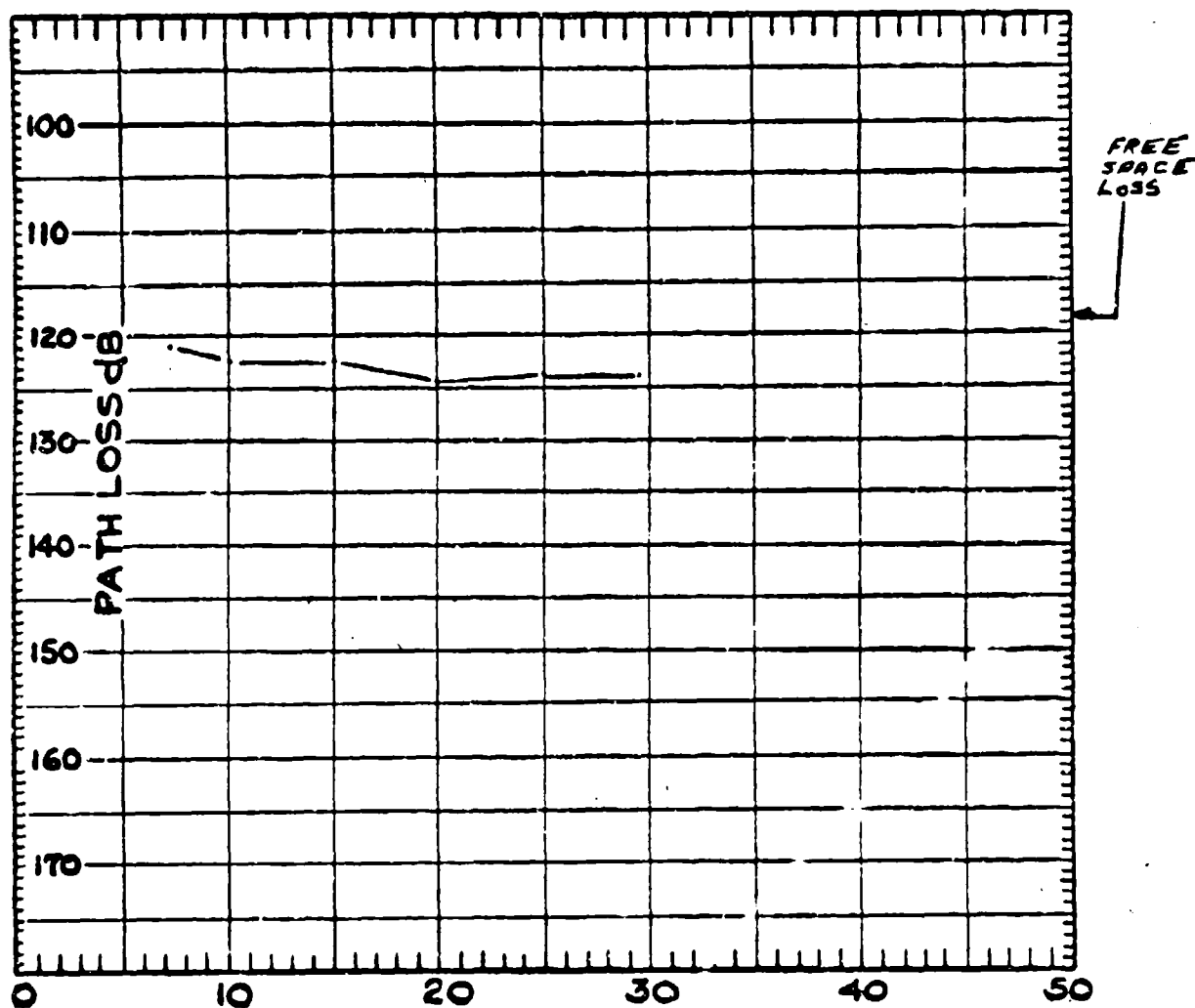






TEST RUN 3/N	AVERAGE PROPAGATION	FEB 72
720201-06	PATH LOSS HIGHLANDS	
SITE NO. 21 TO ECOM HEXAGON		

FREQUENCY: 1545 MHz

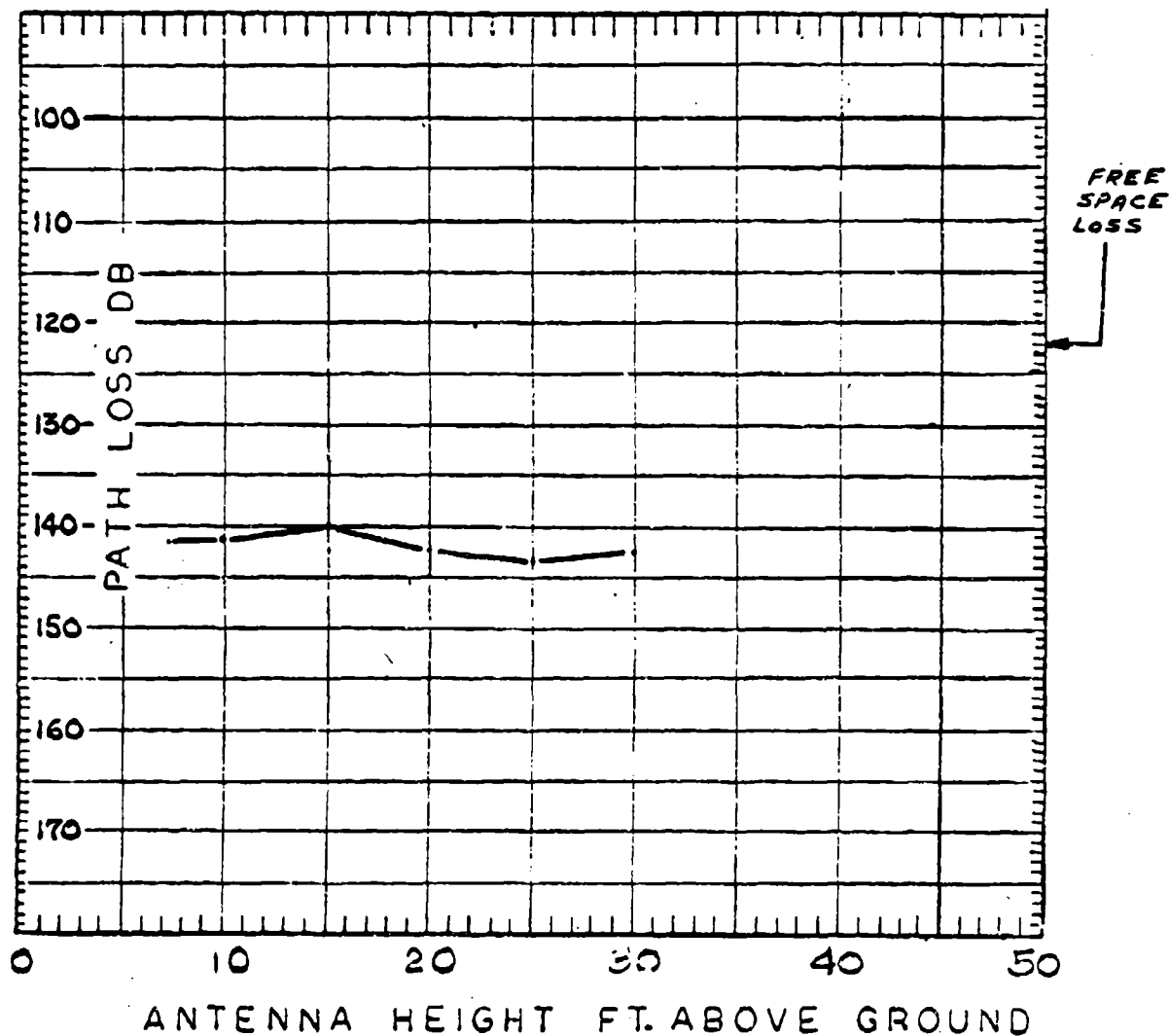


ANTENNA HEIGHT FEET ABOVE GROUND

TEST DATA SHEET								
OPER. FREQ.		1545 MHz		REC. SITE ANT. HT.		DATE:		1 FEB 1968
				FT.		START:		1330 HRS.
SITE		LOCATION	XMITR PWR.	Type ANTENNA	ANT GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)	
TRANSMITTER		HIGHLANDS 21	44 dBm	AEL Horn	14.4	6.5	XMITR. PWR.	-7.0
RECEIVER		ECON HEXAGON		BICONICAL	0.3	1.2	+ANT. GAINS	14.7
TOTAL ANT. GAIN (XMITR + REC.)	14.4 + 0.3 =		14.7		dB		-CABLE LOSSES	7.7
TOTAL CABLE LOSS (XMITR + REC.)	6.5 + 1.2 =		7.7		dB		= ESP =	71.0
XMITR. SITE HEIGHT ABOVE SEA LEVEL	ZOO FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		105		FT.	
XMITR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dbm)	PATH LOSS (db) - (RCVD. PWR.)	AVG. PATH. LOSS (db)	NO. OF SAMP	REMARKS			
7	TEST TEST	720201-06	121	2	WIND 2 KTS 270°			
10	70	—	122	2	GUSTING TO 7-20 KTS			
15	71	—	123	2				
20	72	—	125	2				
25	74	—	124	2				
29' 4"	73	—	124	1				
25	73	—	124					
20	73	—	124					
15	71	—	122					
10	72	—	123					
7	70	—	121		END 720201-06 - 1350			

PROPAGATION PATH LOSS  
DATE : 1 FEBRUARY 72 TEST RUN S/N: 720201-07-08  
PATH: HIGHLANDS SITE NO. 21 TO ECOM HEXAGON

OPER. FREQ. : 2290 MHz



TEST DATA SHEET									
OPER. FREQ. <u>2290 MHz</u>		REC. SITE ANT. HT. <u>FT.</u>		DATE: <u>1 FEBRUARY 72</u>		START: <u>1410 HRS.</u>			
SITE	LOCATION	XMTR PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)			
TRANSMITTER	HIGHLANDS 21	44 dBm	AEL HORN	16.7	8.5	XMTR. PWR. 44			
RECEIVER	ECOM HEXAGON		ANDREW BICONICAL	0.7	1.6	+ANT. GAINS 17.4			
TOTAL ANT. GAIN (XMTR + REC.)		16.7 + 0.7 =		17.4	dB	-CABLE LOSSES 10.4			
TOTAL CABLE LOSS (XMTR + REC.)		8.5 + 1.6 =		10.1	dB	-ESP = 51.0			
XMTR. SITE HEIGHT ABOVE SEA LEVEL		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		14.5		FT.	
XMTR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS		
	TEST	TEST	TEST	TEST					
7	720201-07	91	720201-08	720201-07	141.8	4	WIND 2 KTS 270°		
10	90	91		141	141.3	4	GUSTING TO 20 KTS		
15	89	89		140	140.0	4			
20	89	89		140	142.3	4			
25	89	94		140	143.8	4			
29	89	94		140	142.5	2			
25	94	94		145					
30	94	93		145					
15	89	89		140					
10	90	90		141					
7	90	91		141					
								END 720201-07 - 1435	
								START 720201-08 - 1440	
								END 720201-08 - 1500	

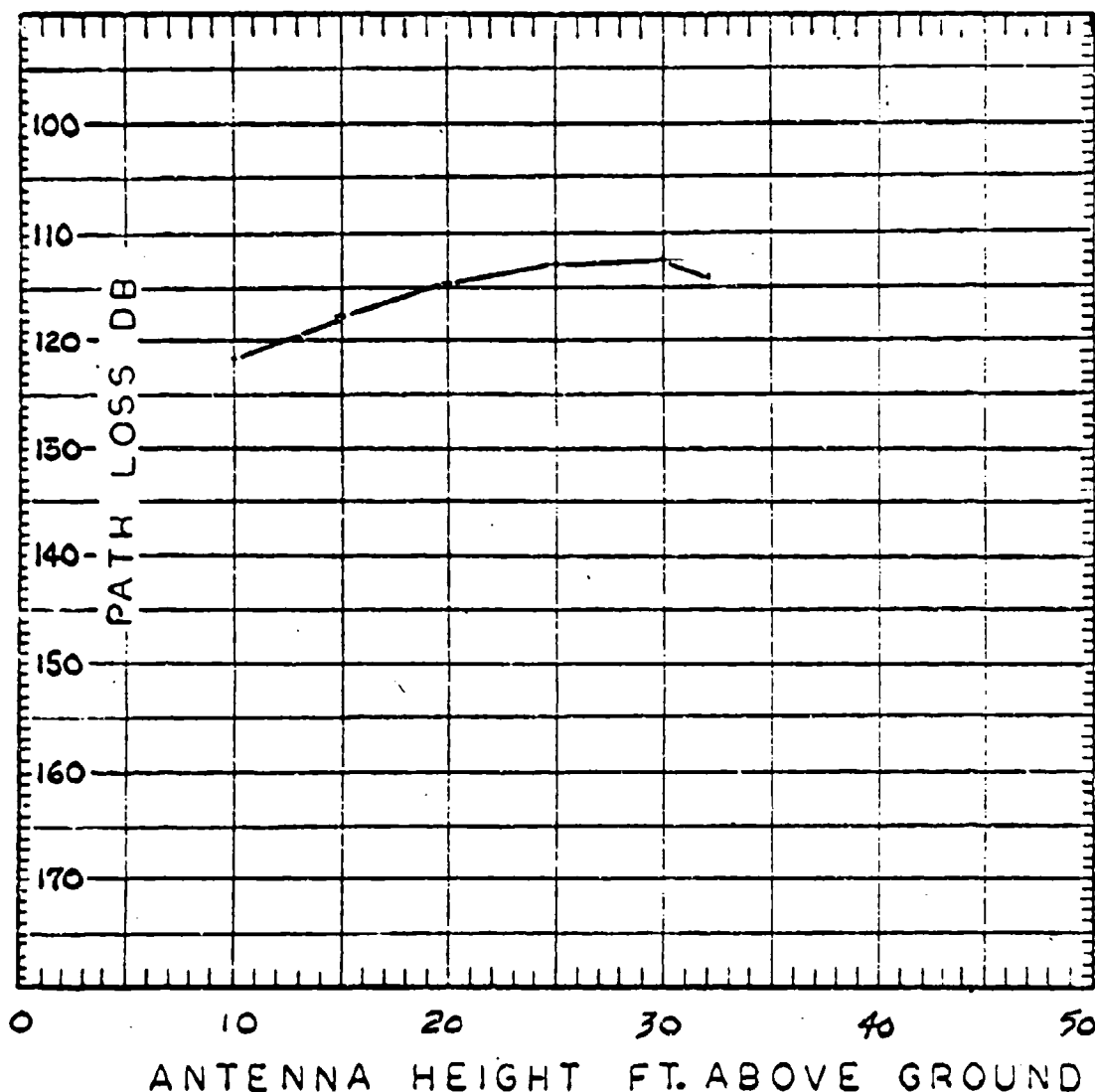
PROPAGATION PATH LOSS

DATE: 7 FEBRUARY 72 TEST RUN SN: 120207-03, -04

PATH: WAYSIDE SITE No. 19 TO ECOM HEXAGON

OPER. FREQ.: 229.5 MHz

FREE  
SPACE  
LOSS  
89.2  
dB



TEST DATA SHEET									
OPER. FREQ.		229.5 MHz		DATE: 7 FEBRUARY 72		HRS.		START: 1040	
SITE		LOCATION		REC. SITE ANT. HT.		FT.		EQUIV. SYS. PWR. (ESP)	
TRANSMITTER		WAYSIDE 19		TYPE ANTENNA		ANT. GAIN (dB)		CABLE LOSSES (dB)	
RECEIVER		ECONOMEX.		XMT. PWR.		17F-197		1.8	
TOTAL ANT. GAIN (XMT + REC.)		1.2 + 1.2 = 2.4		ANT. GAIN (dB)		1.2		1.8	
TOTAL CABLE LOSS (XMT + REC.)		1.8 + 1.8 = 3.6		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140		FT.	
XMT. ANT. HT. ABOVE GND (FT)		720207-03		XMT. PWR.		1.8		FT.	
RCVD. PWR. (dBm)		TEST		TEST		TEST		TEST	
XMT. ANT. HT. ABOVE GND (FT)		720207-03		720207-04		720207-05		720207-06	
10		79		77		122		120	
15		75		74		118		117	
20		71		72		114		115	
25		69		70		112		113	
30		68		70		111		113	
32		71		71		114		114	
30		69		70		112		113	
25		71		70		114		113	
20		71		72		114		115	
15		75		74		118		117	
10		77		80		120		123	
AVG. PATH. LOSS (dB)		121.3		117.5		114.5		113.0	
NO. OF SAMP		4		4		4		4	
REMARKS		END 720207-03 - 1057		START 720207-04 - 1105		END 720207-04 - 1120			

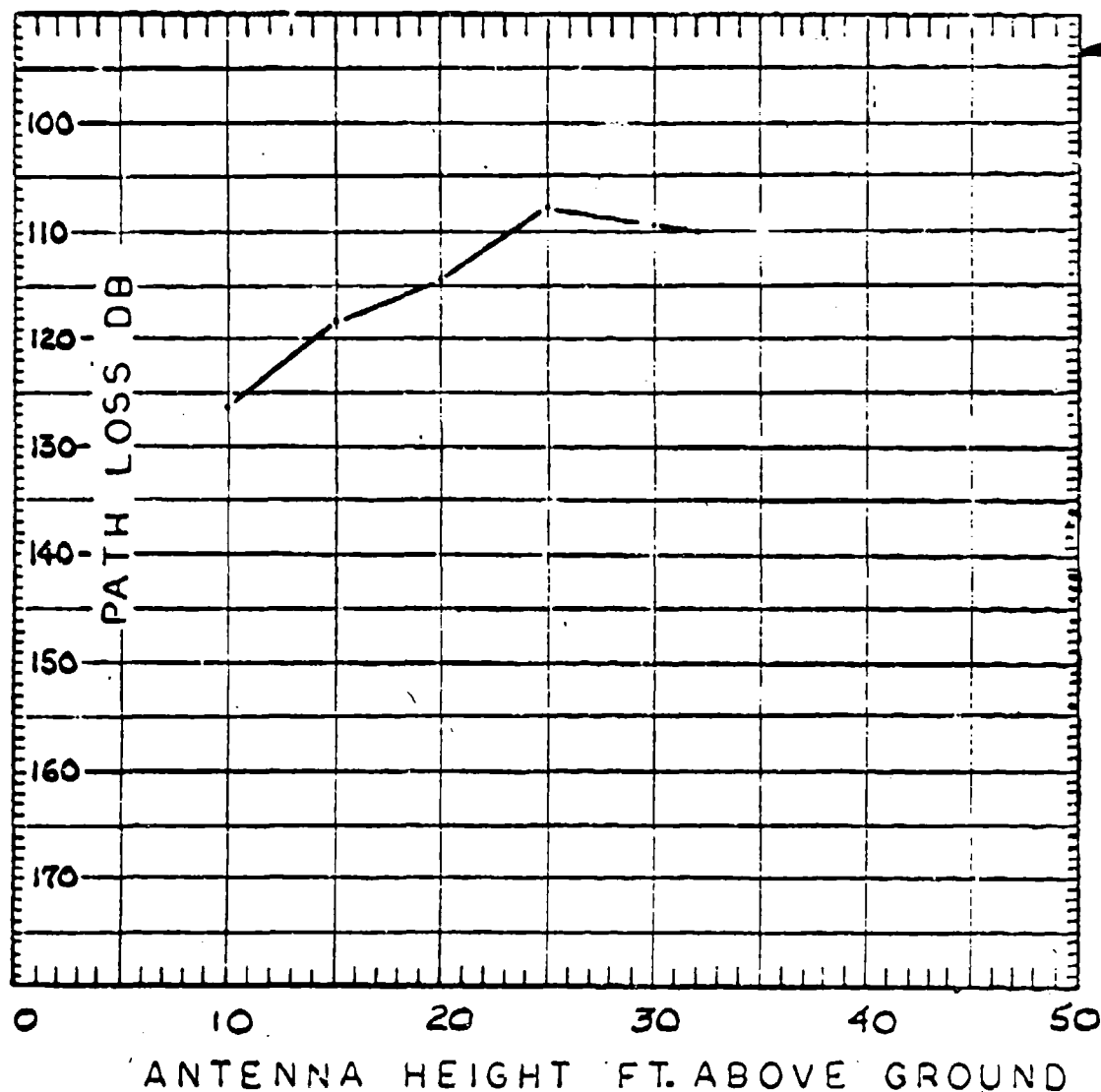
PROPAGATION PATH LOSS

DATE : 7 FEBRUARY 72 TEST RUN S/N: 720207-01, -02

PATH: WAYSIDE SITE NO. 19 TO ECOM HEXAGON

OPER. FREQ. : 371.4 MHz

FREE  
SPACE  
LOSS





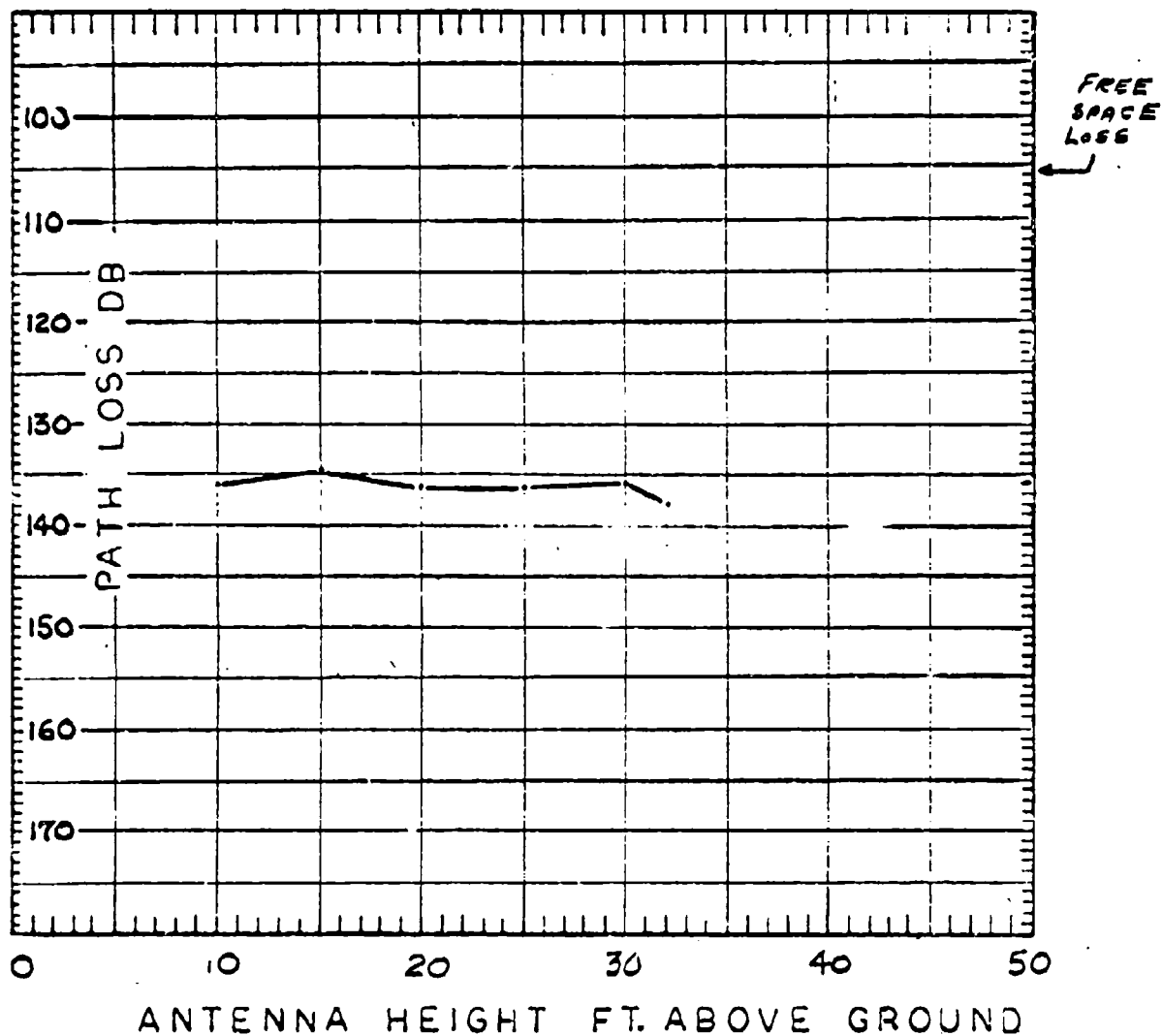
TEST DATA SHEET									
OPER. FREQ.		371.4		DATE: 7 FEBRUARY 72		REC. SITE ANT. HT.		FT.	
SITE		LOCATION		XMIT. PWR.		TYPE ANTENNA		ANT. GAIN (dB)	
TRANSMITTER		WAYSIDE 19		44dBm		AT 197		2.0	
RECEIVER		ECOM HEX.				AT 197		2.0	
TOTAL ANT. GAIN (XMITR + REC.)		2.0 + 2.0 = 4.0		dB				dB	
TOTAL CABLE LOSS (XMITR + REC.)		2.3 + 2.3 = 4.6		dB				dB	
XMITR. SITE HEIGHT ABOVE SEA LEVEL		140		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140	
XMITR. ANT. HT. ABOVE GND (FT)		TEST		TEST		TEST		REMARKS	
720207-01		720207-02		720207-01		720207-02			
10	83	85	126	128	126.3	4			
15	77	73	120	116	118.3	4			
20	70	73	113	116	114.8	4			
25	65	65	108	108	108.0	4			
30	66	66	109	109	109.5	4			
32	67	67	110	110	110.0	2			
30	67	67	110	110					
25	65	65	108	108					
20	70	74	113	117					
15	76	75	119	118					
10	83	82	126	125					
END 720207-01 - 1015									
START 720207-02 - 1020									
END 720207-02 - 1055									

# PROPAGATION PATH LOSS

DATE : 7 FEBRUARY 72 TEST RUN S/N: 720207-05, -06, -08

PATH: WAYSIDE SITE No. 19 TO ECOM HEXAGON

OPER. FREQ. : 1545 MHz



TEST DATA SHEET																																																																																																																	
OPKR. FREQ.		1545 MHz		DATE: 7 FEBRUARY 72		REC. SITE ANT. HT.		FT.																																																																																																									
SITE		LOCATION		TYPE		ANT. GAIN (dB)		CABLE LOSSES (dB)																																																																																																									
TRANSMITTER		WAYSIDE 19		ANTENNA		2.5		5.7																																																																																																									
RECEIVER		ECOM HEX.		ANTENNA		0.3		1.2																																																																																																									
TOTAL ANT. GAIN (XMTR + REC.)		2.5 + 0.3 = 2.8		dB																																																																																																													
TOTAL CABLE LOSS (XMTR + REC.)		5.7 + 1.2 = 6.9		dB																																																																																																													
XMTR. SITE HEIGHT ABOVE SEA LEVEL		140		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		145																																																																																																									
EQUIV. SYS. PWR. (ESP)						XMTR. PWR.		43																																																																																																									
+ ANT. GAINS								2.8																																																																																																									
- CABLE LOSSES								6.9																																																																																																									
= ESP =								38.9 USE 39																																																																																																									
<table border="1"> <thead> <tr> <th rowspan="2">XMTR. ANT. HT. ABOVE GND (FT)</th> <th colspan="2">RCVD. PWR. (dBm)</th> <th colspan="2">PATH LOSS (dB) = (ESP) - (RCVD. PWR.)</th> <th rowspan="2">AVG. PATH. LOSS (dB)</th> <th rowspan="2">NO. OF SAMP</th> <th rowspan="2">REMARKS</th> </tr> <tr> <th>TEST</th> <th>TEST</th> <th>720207-05</th> <th>720207-07</th> </tr> </thead> <tbody> <tr> <td>16</td> <td>97</td> <td>104</td> <td>196</td> <td>143</td> <td>136.1</td> <td>6</td> <td rowspan="5">RUN 720207-07 COND. T.I.D. WITH ANTENNA AT 75' IN BRUNES TOWER TO CHECK PREVIOUS RESULTS NO MEASUREMENTS TAKEN</td> </tr> <tr> <td>15</td> <td>93</td> <td>97</td> <td>132</td> <td>136</td> <td>134.8</td> <td>6</td> </tr> <tr> <td>20</td> <td>100</td> <td>100</td> <td>139</td> <td>139</td> <td>136.5</td> <td>6</td> </tr> <tr> <td>25</td> <td>100</td> <td>100</td> <td>139</td> <td>139</td> <td>136.5</td> <td>6</td> </tr> <tr> <td>30</td> <td>100</td> <td>97</td> <td>139</td> <td>136</td> <td>136.0</td> <td>6</td> </tr> <tr> <td>32</td> <td>102</td> <td>100</td> <td>141</td> <td>139</td> <td>138.0</td> <td>3</td> <td></td> </tr> <tr> <td>30</td> <td>100</td> <td>95</td> <td>139</td> <td>134</td> <td></td> <td></td> <td>AVG. PATH LOSS INCLUDES RUNS 720207-05, 720207-06 AND 720207-08</td> </tr> <tr> <td>25</td> <td>98</td> <td>97</td> <td>137</td> <td>136</td> <td></td> <td></td> <td>END 720207-05 - 1330</td> </tr> <tr> <td>20</td> <td>97</td> <td>99</td> <td>136</td> <td>138</td> <td></td> <td></td> <td>START 720207-06 - 1400</td> </tr> <tr> <td>15</td> <td>96</td> <td>97</td> <td>135</td> <td>136</td> <td></td> <td></td> <td>END 720207-06 - 1420</td> </tr> <tr> <td>10</td> <td>96</td> <td>95</td> <td>135</td> <td>134</td> <td></td> <td></td> <td>START 720207-07 - 1445</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>END 720207-07 - 1500</td> </tr> </tbody> </table>										XMTR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS	TEST	TEST	720207-05	720207-07	16	97	104	196	143	136.1	6	RUN 720207-07 COND. T.I.D. WITH ANTENNA AT 75' IN BRUNES TOWER TO CHECK PREVIOUS RESULTS NO MEASUREMENTS TAKEN	15	93	97	132	136	134.8	6	20	100	100	139	139	136.5	6	25	100	100	139	139	136.5	6	30	100	97	139	136	136.0	6	32	102	100	141	139	138.0	3		30	100	95	139	134			AVG. PATH LOSS INCLUDES RUNS 720207-05, 720207-06 AND 720207-08	25	98	97	137	136			END 720207-05 - 1330	20	97	99	136	138			START 720207-06 - 1400	15	96	97	135	136			END 720207-06 - 1420	10	96	95	135	134			START 720207-07 - 1445								END 720207-07 - 1500
XMTR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS																																																																																																										
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30	100	97	139	136	136.0	6																																																																																																											
32	102	100	141	139	138.0	3																																																																																																											
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10	96	95	135	134			START 720207-07 - 1445																																																																																																										
							END 720207-07 - 1500																																																																																																										

TEST DATA SHEET										DATE: 7 FEBRUARY 72	
OPER. FREQ.		1545 MHz		REC. SITE ANT. HT.		FT.		START: 1520		HRS.	
SITE	LOCATION	XMTR. PWR.	TYPE	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)					
TRANSMITTER	WAYSIDE 19	43 dBm	ANTENNA DISCONNECT	2.5	5.7	XMTR. PWR. 43					
RECEIVER	ECOM Hex.		ANTENNA DISCONNECT	0.3	1.2	+ANT. GAINS 2.8					
TOTAL ANT. GAIN (XMTR + REC.)		2.5 + 0.3 = 2.8		dB		-CABLE LOSSES 6.9					
TOTAL CABLE LOSS (XMTR + REC.)		5.7 + 1.2 = 6.9		dB		=ESP = 38.9 USE 39					
XMTR. SITE HEIGHT ABOVE SEA LEVEL		140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		145 FT.					
XMTR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)	TEST	TEST	TEST	PATH LOSS (dB) = (ESP) - (RCVD. PWR.)	AVG. PATH. LOSS (dB)	NO. OF SAMPL	REMARKS			
10	96	720207-08			720207-08			AVG. PATH LOSS			
15	95				135			INCLUDED WITH			
20	94				134			RUNS 720207-05			
25	95				133			AND 720207-06			
30	95				134						
32	95				134						
30	95				134						
25	95				134						
20	95				134						
15	97				136						
10	95				134						

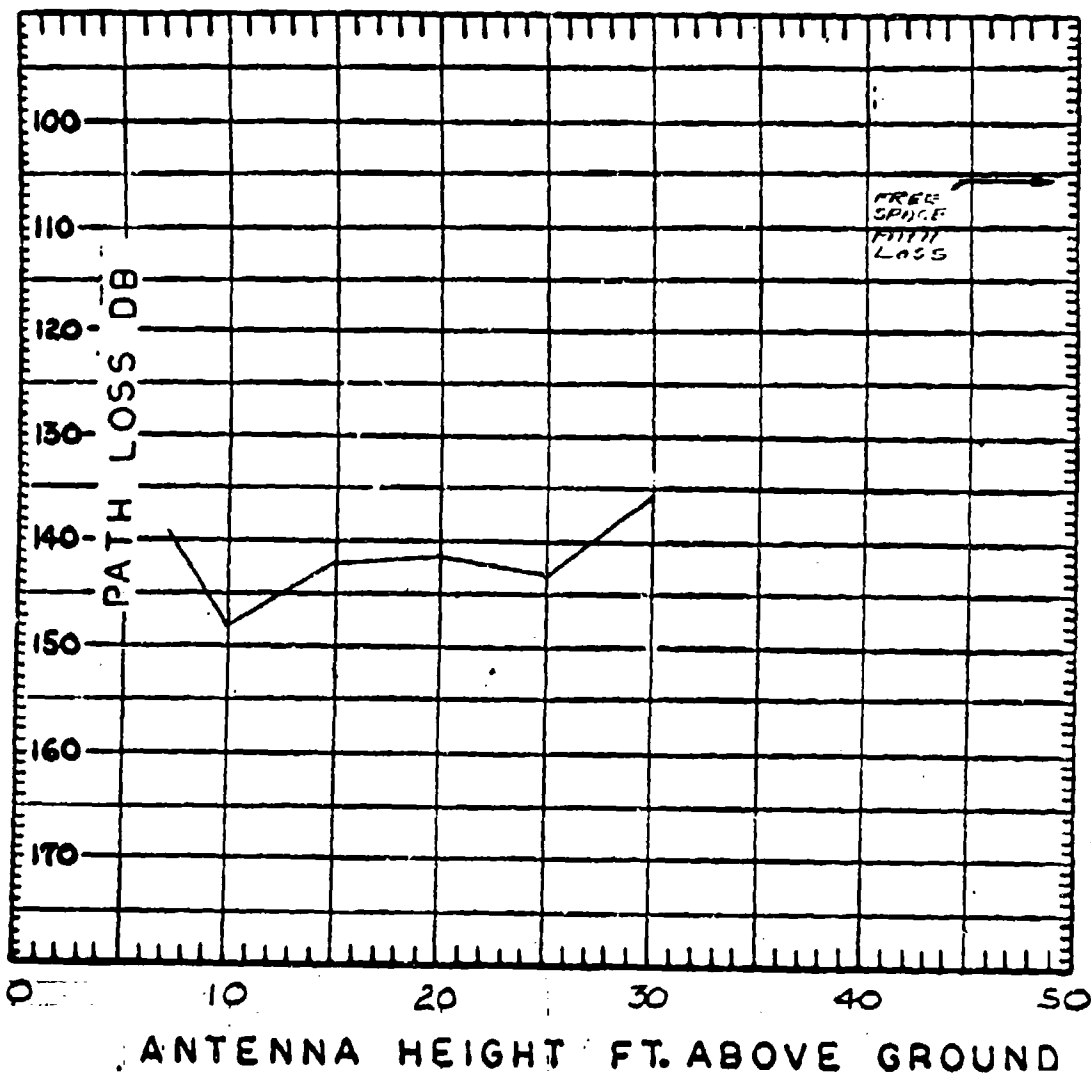
[illegible]

# PROPAGATION PATH LOSS

DATE: 8 FEB 72 TEST RUN S/N: 720208.01402

PATH: WAYSIDE 19 TO ECOM HEXAGON

OPER. FREQ.: 1545 MHz



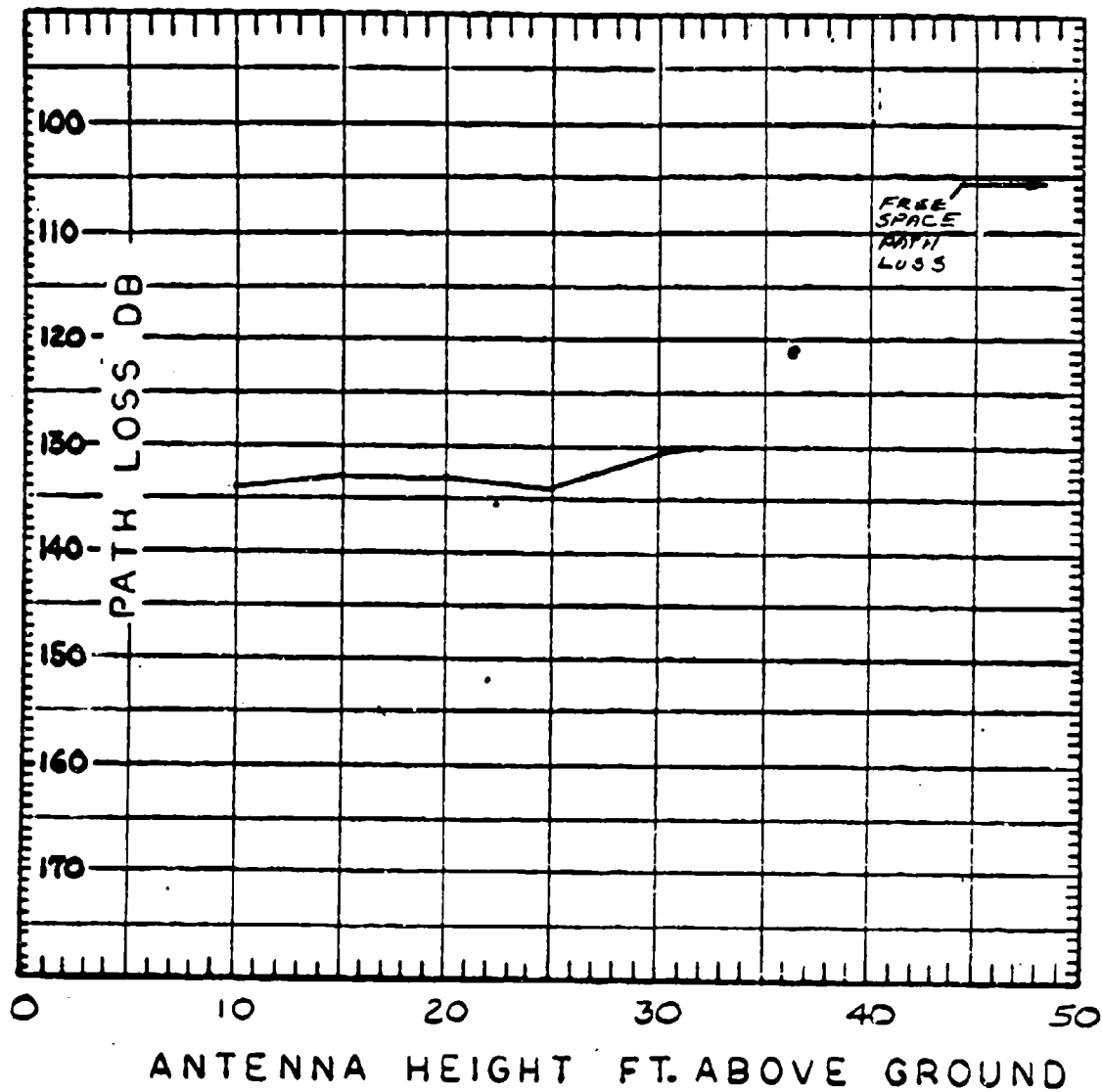
TEST DATA SHEET									
OPER. FREQ.		154W MHz		DATE: 8 FEB 72		START: _____		MRS.	
SITE		LOCATION		REC. SITE ANT. HT.		FT.		EQUIV. SYS. PWR. (ESP)	
TRANSMITTER		WRYSIDE 19		TYPE ANTENNA		ANT. GAIN (dB)		CABLE LOSSES (dB)	
RECEIVER		ECOM HEX		PWR. 44dB		19.4		5.7	
TOTAL ANT. GAIN (XMT + REC.)		14.4 + 0.3 =		14.7 dB		0.3		1.2	
TOTAL CABLE LOSS (XMT + REC.)		5.7 + 1.2 =		6.9 dB				-CABLE LOSSES 6.7	
XMT. SITE HEIGHT ABOVE SEA LEVEL		140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140 FT.		-ESP = 5.8 USE 52	
XMT. ANT. HT. ABOVE GND (FT)		RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)		NO. OF SAMP	
TEST	TEST	TEST	TEST	TEST	TEST	TEST	TEST	TEST	TEST
7'3"	88	720208.01	720208.02	140	139	139.5	4		
10	99			151	147	148	4		
15	84			136	136	137	4		
20	84			136	137	136.5	4		
25	85			137	138	138	4		
30	84			136	135	135.5	2		
25	85			137	139				
20	84			136	137				
15	84			136	138				
10	95			147	147				
7'3"	87			139	140				
Pos. PEAK AVERAGING OF STRIP CHART RECORDINGS									

PROPAGATION PATH LOSS

DATE: 8 FEB. 72 TEST RUN S/N: 720208.03 '04

PATH: WAYSIDE 19 TO ECOM HEXAGON

OPER. FREQ.: 1545 MHz





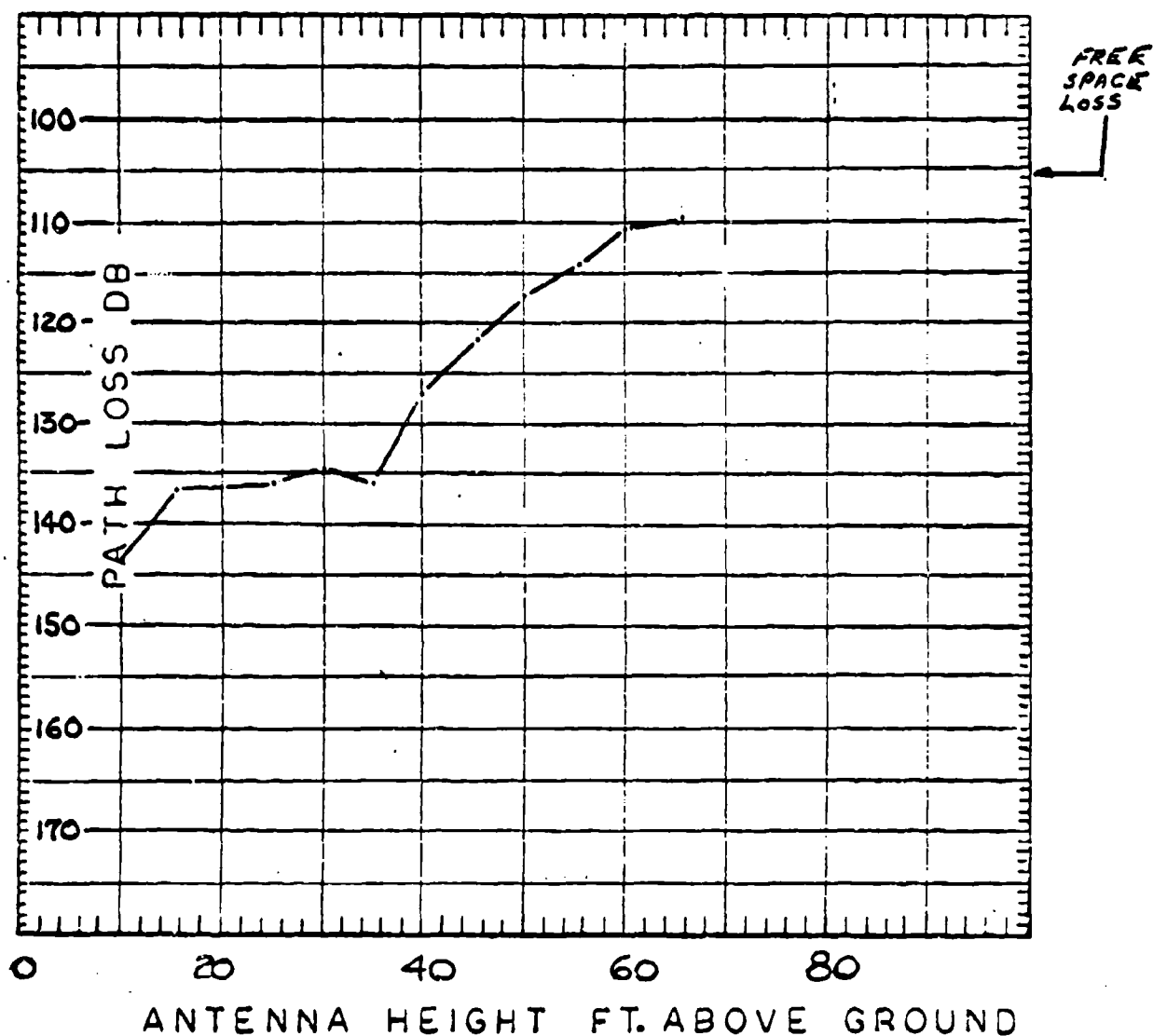
TEST DATA SHEET									
OPER. FREQ. 154.5 MHz		DATE: 8 FEB 72		HRS.		START:		FT.	
SITE		LOCATION		REC. SITE ANT. HT.		ANT. GAIN		CABLE LOSSES	
TRANSMITTER		WAYSIDE 19		XMT. PWR. 44 dBm		TYPE ANTENNA		EQUIV. SYS. PWR. (ESP)	
RECEIVER		ECOM HEX.		XMT. PWR. 44 dBm		ANDREW DISCONE		XMT. PWR. 44	
TOTAL ANT. GAIN (XMT. + REC.)		2.5 + 0.3 = 2.8		ANT. GAIN		0.3		+ ANT. GAINS 2.8	
TOTAL CABLE LOSS (XMT. + REC.)		5.7 + 1.2 = 6.9		RCVR. ANT. HEIGHT ABOVE SEA LEVEL 140		FT.		- CABLE LOSSES 6.9	
XMT. ANT. HT. ABOVE GND (FT)		720208.03		XMT. PWR. (dBm)		TEST		REMARKS	
10	95.7	91.3	720208.04	135.7	131.3	134	4		
15	96.3	89.8		136.3	129.8	133	4		
20	94.8	92.5		134.8	133.5	133	4		
25	91.6	92.3		131.6	132.3	134	4		
30	91.4	91.5		131.4	131.5	131	4		
32	91.6	87.3		131.6	127.3	130	2		
30	89.9	91.1		129.9	131.4				
25	94.3	95.9		134.3	135.9				
20	91.3	93.0		131.3	133.0				
15	94.1	93.3		134.1	133.3				
10	92.4	97.0		132.4	137.0				
Pos. LEAK AVERAGING OF STRIP CHART RECORDINGS									

# PROPAGATION PATH LOSS

DATE : 8 FEBRUARY 72 TEST RUN S/N: 720208-06, 07, 08

PATH : WAYSIDE SITE No. 19B TO ECOM HEXAGON

OPER. FREQ. : 154.5 MHz

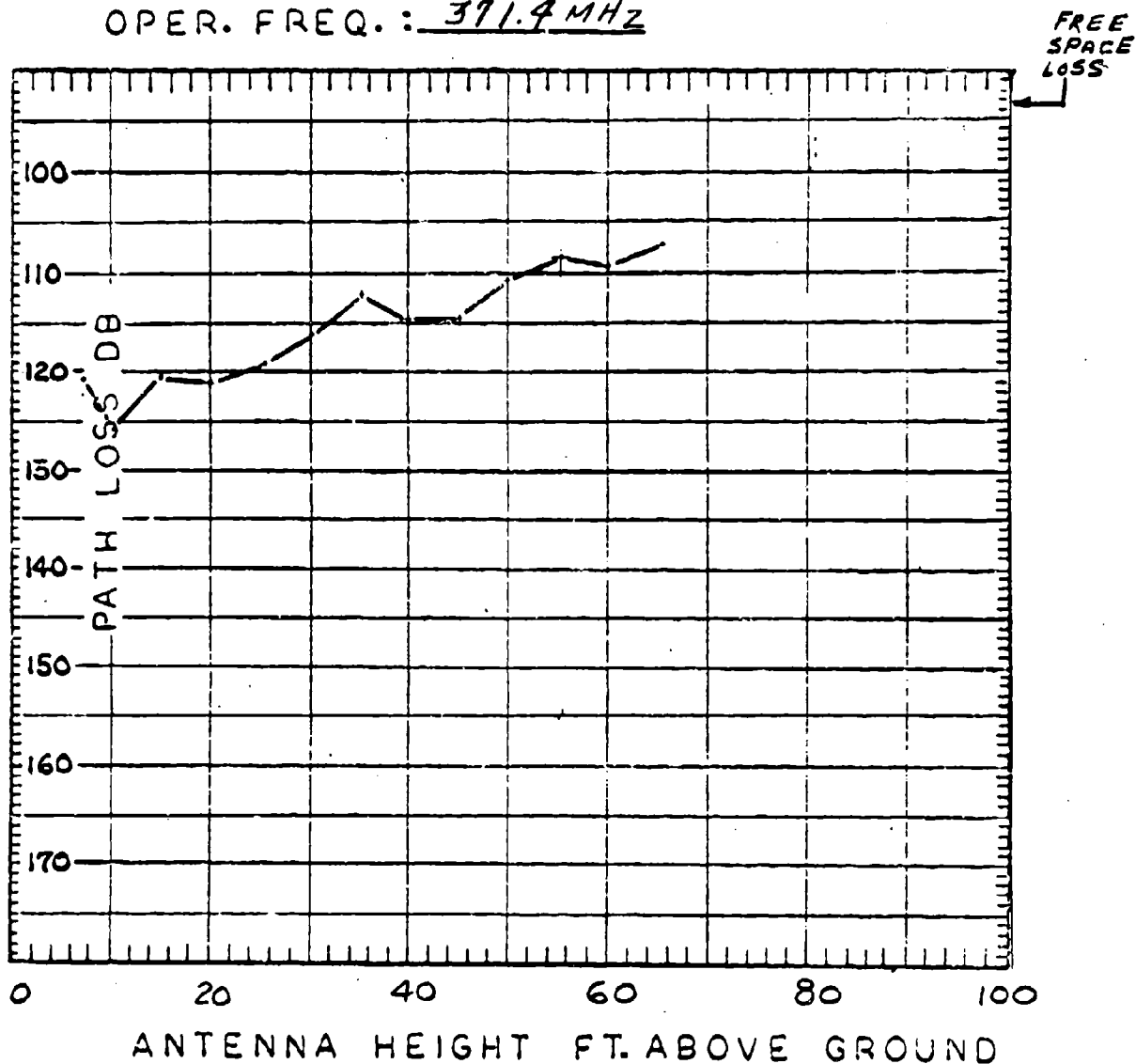


TEST DATA SHEET									
OPER. FREQ.		1545 MHz		DATE: 8 FEBRUARY 72		REC. SITE ANT. HT.		FT.	
SITE		LOCATION		XMITR. PWR.		TYPE ANTENNA		ANT. GAIN (dB)	
TRANSMITTER		WINDSIDE 19B		44 dBm		REL. HORN		14.4	
RECEIVER		ECOM HLEX.				ANDREW ALCONICOL		0.3	
TOTAL ANT. GAIN (XMITR + REC.)		14.4 + 0.3 = 14.7						dB	
TOTAL CABLE LOSS (XMITR + REC.)		5.7 + 1.2 = 6.9						dB	
XMITR. SITE HEIGHT ABOVE SEA LEVEL		140		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140	
XMITR. ANT. HT. ABOVE GND (FT)		TEST		RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	
		TEST		TEST		TEST		NO. OF SAMP	
10	720208.06	720208.07	720208.08	720208.06	720208.07	720208.08	143.3	4	TRACKING TESTS WITH ANT. IN BRUNES TOWER
15	93	89	91	145	141	143	136.8	4	
20	87	83	87	139	135	139	136.3	4	
25	87	85	82	139	137	134	131.0	4	
30	82	79	77	134	131	129	129.8	4	
35	79	78	76	131	130	128	131.0	4	
40	79	79	79	129	131	131	127.0	4	
45	76	74	74	128	126	126	121.8	4	
50	70	70	69	122	122	121	117.3	3	
55	65	65	65	117	117	117	114.0	4	
60	62	63	64	114	115	116	110.8	4	CABLE PROBLEMS RUN 720208-08
65	59	59	59	111	111	111	109.7	3	
70	57	58	58	109	110	110			
75	58			110					
80	58			115					
85	63			118					MEAN READING OF STRIP CHART RECORDING
90	66			122					
95	70			128					
100	76			131					
105	79			130					
110	78			130					
115	78			130					

TEST DATA SHEET									
OPER. FREQ.		1545 MHz		REC. SITE ANT. HT.		FT.		DATE: 8 FEBRUARY 76	
								START: 1925 HRS.	
SITE		LOCATION		XMITR PWR.		TYPE ANTENNA		ANT GAIN (dB)	
TRANSMITTER		Wayside NB		44 dBm		HORN		14.4	
RECEIVER		Ecom Hex.				ANDREW BUCONIERI		0.3	
TOTAL ANT. GAIN (XMITR + REC.)	14.4 + 0.3 = 14.7 dB								
TOTAL CABLE LOSS (XMITR + REC.)	5.7 + 1.2 = 6.9 dB								
XMITR. SITE HEIGHT ABOVE SEA LEVEL	140 FT.								
RCDV. PWR. (dbm)	TEST	TEST	TEST	TEST	TEST	PATH LOSS (dB) = (RCVD. PWR.) - (ESP)	Avg. PATH. LOSS (dB)	NO. OF SAMP	REMARKS
20	720208-06	720208-07	720208-08	720208-06	720208-07	720208-08			
15	83	/	/	135	/	/			END 720208-06 - 1450
10	82	/	/	134	/	/			START 720208-07 - 1455
9.7	92	/	/	144	/	/			END 720208-07 - 1500
9.7	92	/	/	144	/	/			START 720208-08 - 1507
									END 720208-08 - 1515
MEAN READING OF STRIP CHART RECORDINGS									

PROPAGATION PATH LOSS  
DATE : 9 FEBRUARY 72 TEST RUN S/N: 720209-07-08  
PATH : WAYSIDE SITE NO. 19B TO ECOM HEXAGON

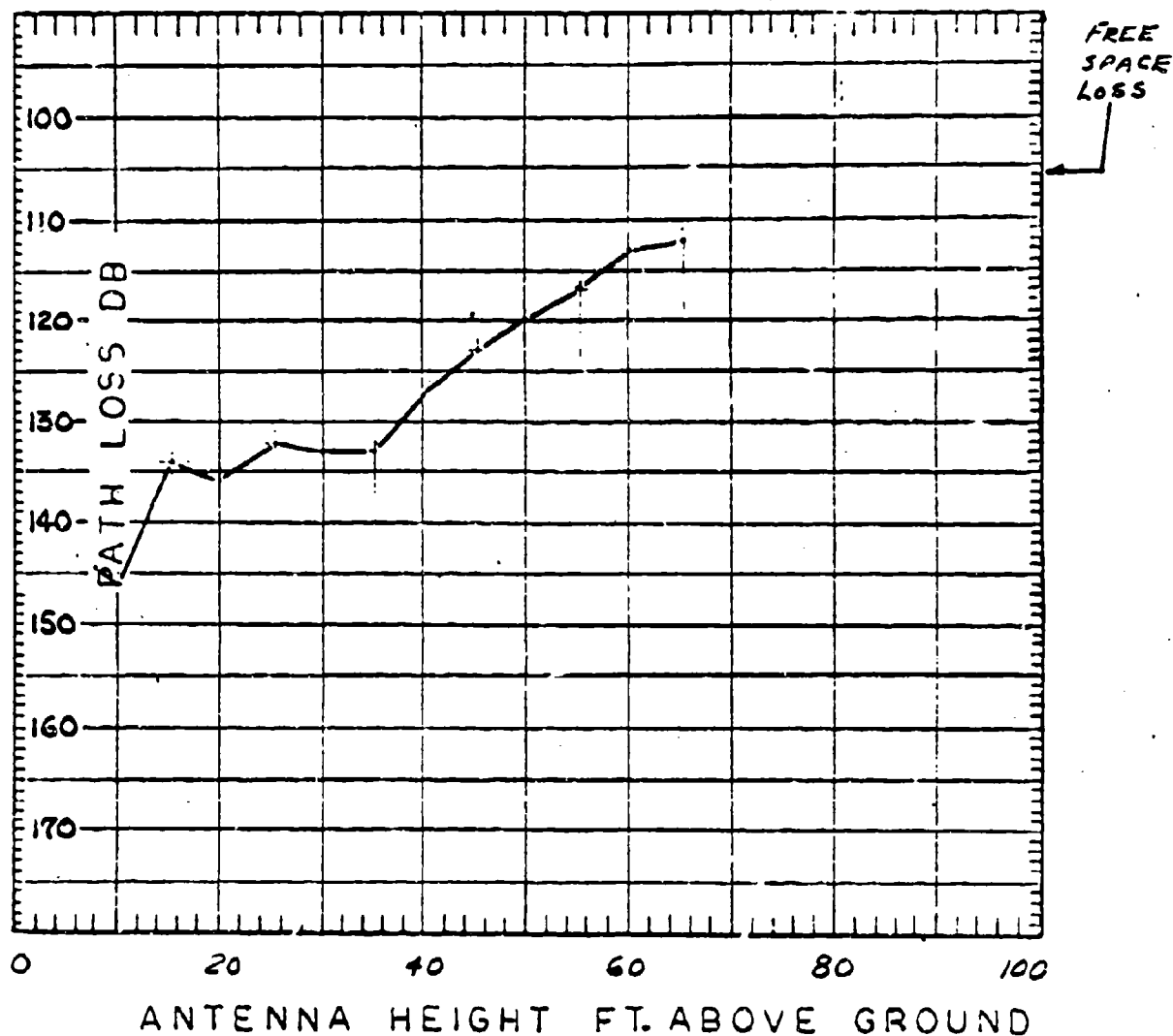
OPER. FREQ. : 371.4 MHz



TEST DATA SHEET									
OPER. FREQ.		371.4 MHz		DATE: 9 FEBRUARY 72		FT.		START: 1538 HRS.	
SITE		LOCATION		REC. SITE ANT. HT.		ANT. GAIN		CABLE LOSSES (dB)	
TRANSMITTER		WAYSIDE 19B		XMT. PWR.		TYPE ANTENNA		ANT. GAIN (dB)	
RECEIVER		ECOM HEX.		44dBm		AT-197		2.0	
TOTAL ANT. GAIN (XMT + REC.)		2.0 + 2.0 = 4.0		dB		2.0		2.3	
TOTAL CABLE LOSS (XMT + REC.)		2.3 + 2.3 = 4.6		dB		2.0		2.3	
XMT. SITE HEIGHT ABOVE SEA LEVEL		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		FT.		EQUIV. SYS. PWR. (ESP)	
XMT. ANT. HT. ABOVE GND (FT)		RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)		NO. OF SAMP	
TEST		TEST		TEST		TEST		TEST	
10	82	720209-07	720209-08	125	126	125.5	2		
15	77	78	78	120	121	120.5	2		
20	78	78	78	121	121	121.0	2		
25	76	76	76	119	119	119.0	2		
30	74	72	72	117	115	116.0	2		
35	69	69	69	112	112	112.0	2		
40	73	70	70	116	113	114.5	2		
45	75	68	68	118	111	114.5	2		
50	68	67	67	111	110	110.5	2		
55	66	65	65	109	108	108.5	2		
60	67	66	66	110	109	109.5	2		
65	65	64	64	108	107	107.5	2		
7	-	78	78	-	121	121	1		

PROPAGATION PATH LOSS  
DATE : 9 FEBRUARY 72 TEST RUN S/N: 720209-01-02  
PATH : WAYSIDE SITE No. 19B TO ECOM HEXAGON

OPER. FREQ. : 1545 MHz

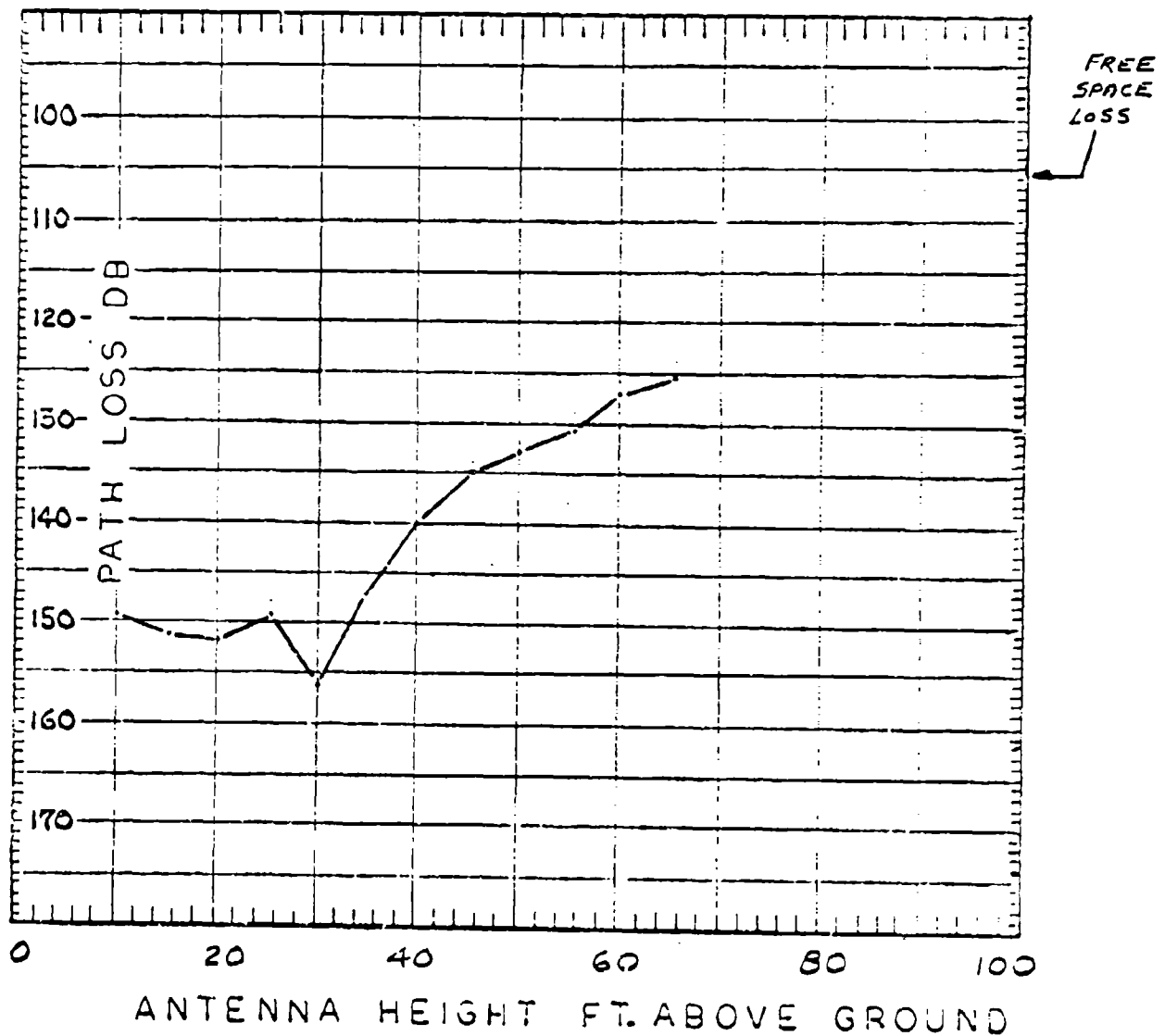






PROPAGATION PATH LOSS  
DATE: 9 FEBRUARY 72 TEST RUN SIN: 720201-0304, FOR  
PATH: WAYSIDE SITE NO 19B TO ECOM HEYAGON

OPER. FREQ.: 1545 MHz



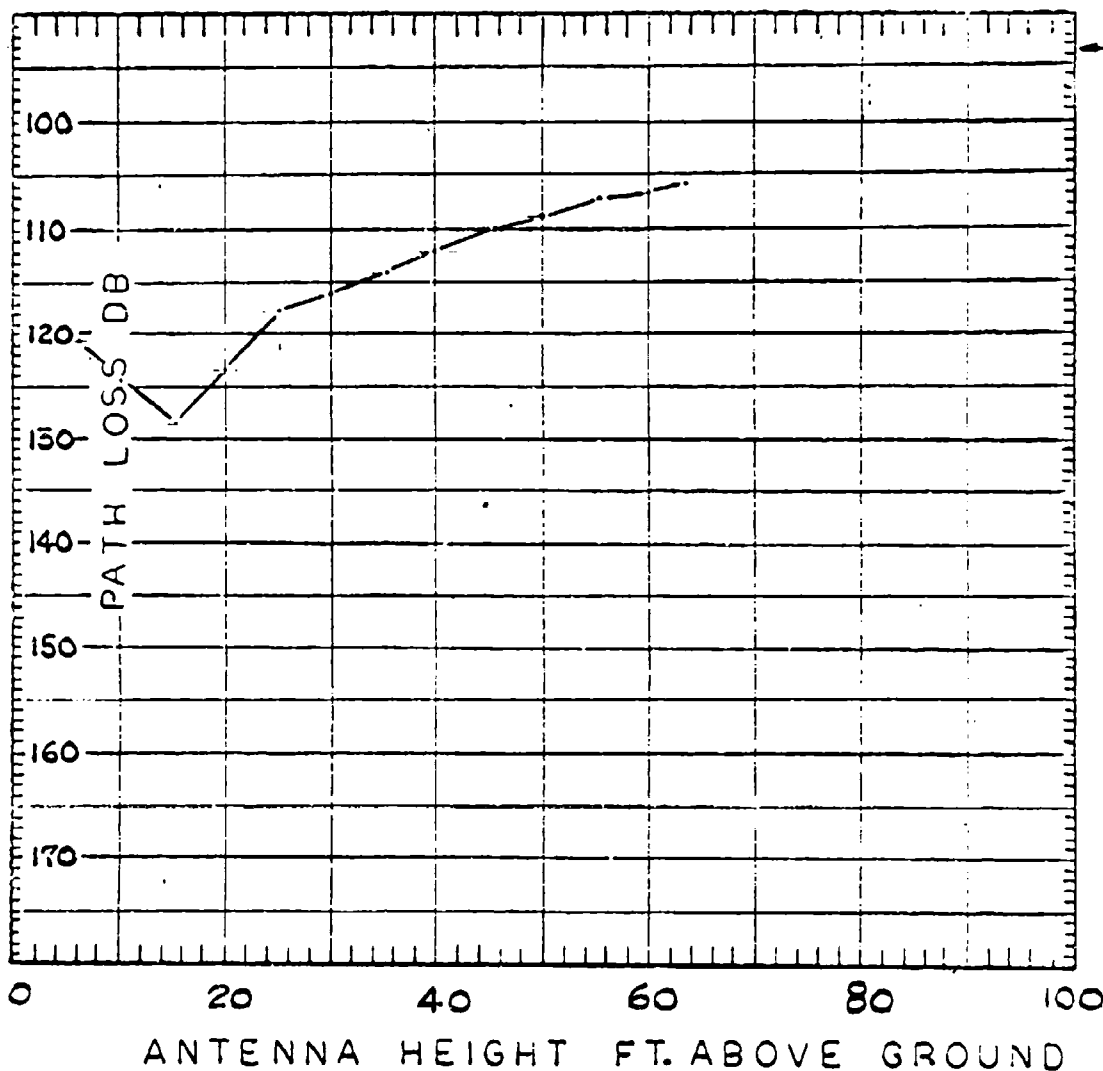
TEST DATA SHEET									
OPER. FREQ.		154.5 MHz		DATE: 9 FEBRUARY 72		REC. SITE ANT. HT.		FT.	
SITE		LOCATION		XMT. PWR.		TYPE		ANT. GAIN (dB)	
TRANSMITTER		WAYSIDE 17B		44 dBm		ANTENNA		14.4	
RECEIVER		ECOM HEX.				BICONICAL		0.3	
TOTAL ANT. GAIN (XMT + REC.)		14.4 + 0.3 = 14.7		dB		CABLE LOSSES (dB)		5.7	
TOTAL CABLE LOSS (XMT + REC.)		5.7 + 1.2 = 6.9		dB		EQUIV. SYS. PWR. (ESP)		44	
XMT. SITE HEIGHT ABOVE SEA LEVEL		140		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140	
XMT. ANT. HT. ABOVE GND (FT.)		TEST		TEST		TEST		TEST	
10		98		97		97		97	
15		102		98		98		98	
20		101		102		97		97	
25		97		98		102		102	
30		107		105		95		95	
35		97		93		88		88	
40		82		88		83		83	
45		82		81		80		80	
50		79		78		78		78	
55		77		74		74		74	
60		75		73		73		73	
65		72		72		72		72	
65		73		73		73		73	
65		72		72		72		72	
65		73		73		73		73	
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65		73		73		73		73	
65		72		72		72		72	
65		73		73		73		73	
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65		73		73		73		73	
65		72		72		72		72	
65		73		73		73		73</	

# PROPAGATION PATH LOSS

DATE : 14 FEBRUARY 72 TEST RUN S/N: 720214-01 02 03

PATH : WAYSIDE SITE NO. 194 TO ECON HEXAGON

OPER. FREQ. : 371.4 MHz



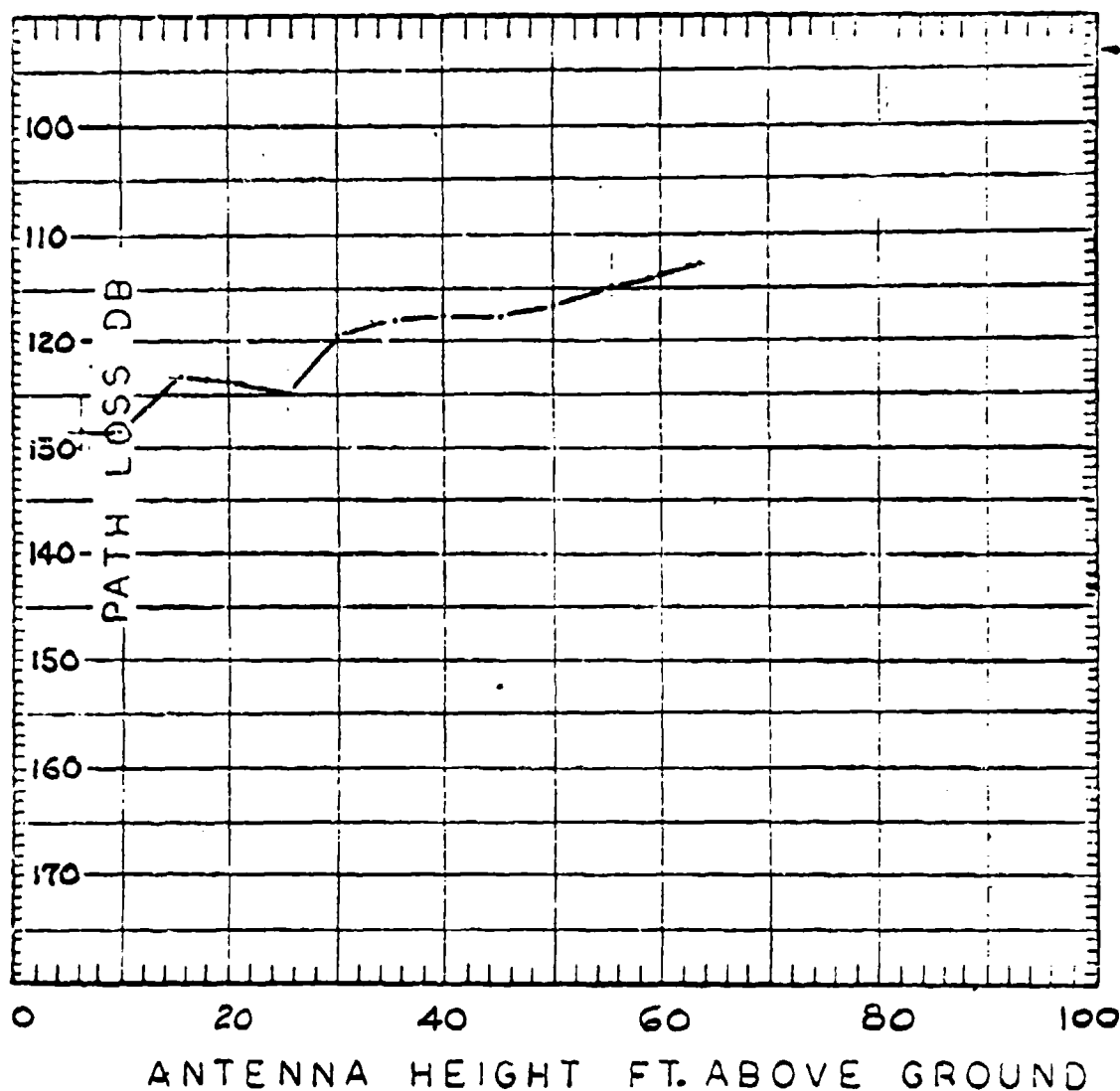
TEST DATA SHEET									
OPER. FREQ. 371.4 MHz		DATE: 14 FEBRUARY 1972		REC. SITE ANT. HT. FT.		START: 1105			
SITE	LOCATION	XMT. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)	XMT. PWR.	+ ANT. GAINS	- CABLE LOSSES
TRANSMITTER	WAXSIDE 19B	44.0 dB	T-29	8.0	2.3	44.0			
RECEIVER	ECOM 1/2 XN-201		AF-197	2.0	2.3			10.0	4.6
TOTAL ANT. GAIN (XMT. + REC.)		8.0 + 2.0 = 10.0 dB							
TOTAL CABLE LOSS (XMT. + REC.)		2.3 + 2.3 = 4.6 dB							
XMT. SITE HEIGHT ABOVE SEA LEVEL		190 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140 FT.			
XMT. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAHP	REMARKS		
	TEST	TEST	720214.01	720214.02				720214.03	
6	72	71	72	121	120	121	3	TRANSMITTING ANTENNA	
10	75	76	76	124	125	125	3	VERTICALLY	
15	79	80	79	128	129	128	3	POLARIZED	
20	74	77	73	123	126	122	3		
25	70	69	68	119	118	117	3		
30	68	67	67	117	116	116	3		
35	65	66	64	114	115	113	3		
40	63	-	63	112	-	112	2		
45	61	-	61	110	-	110	2		
50	60	-	60	109	-	109	2		
55	59	-	58	108	-	107	2		
60	58	-	58	107	-	107	2		
63	57	-	57	106	-	106	2		
								END 720214.01 → 1110	
								START 720214.02 → 1119	
								END 720214.02 → ?	
								START 720214.03 → 1127	
								END 720214.03 → 1132	

# PROPAGATION PATH LOSS

DATE: 14 FEBRUARY 72 TEST RUN S/N: 720214-04405  
PATH: WAYSIDE SITE NO. 19B TO ECOM HEXAGON

OPER. FREQ.: 371.4 MHz

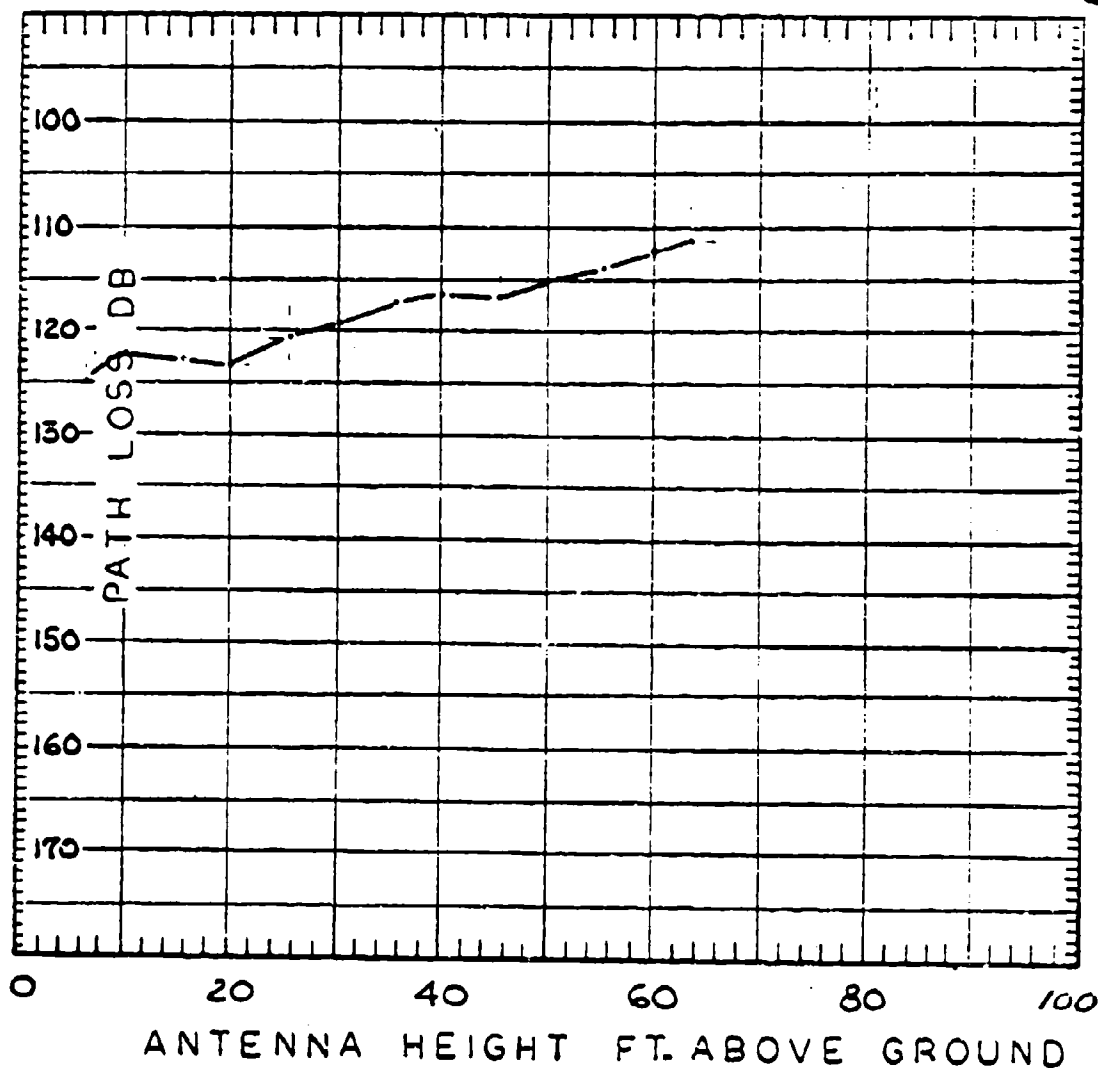
FREE  
SPACE  
LOSS



TEST DATA SHEET									
OPER. FREQ. 371.4		DATE: 14 FEBRUARY 1972		REC. SITE ANT. HT. FT.		START: 1145 HRS.			
SITE		LOCATION		XMIT. PWR.		TYPE ANTENNA		ANT. GAIN (dB)	
TRANSMITTER		WHYSIDE 19B		44 dBm		T-29		8.0	
RECEIVER		ECOM Hexagw				AT-197		2.0	
TOTAL ANT. GAIN (XMIT + REC.)		8.0 + 2.0 = 10.0		dB				CABLE LOSSES (dB)	
TOTAL CABLE LOSS (XMIT + REC.)		2.3 + 2.3 = 4.6		dB				EQUIV. SYS. PWR. (ESP)	
XMIT. SITE HEIGHT ABOVE SEA LEVEL 140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL 140 FT.						XMIT. PWR. 44.0	
								+ ANT. GAINS 10.0	
								- CABLE LOSSES 4.6	
								= ESP = 49.4 USE 19	
XMIT. ANT. HT. ABOVE GND (FT)		RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)		NO. OF SAMP	
TEST		TEST		TEST					
6	720214-04	720214-05	79	129	128	128.5	2	TRANSMITTING	
10	80	79	129	129	128	128.5	2	ANTENNA HORIZONTAL	
15	74	75	123	123	124	123.5	2	POLARIZED	
20	71	76	123	124	125	124.0	2		
25	75	77	124	124	126	125.0	2		
30	70	71	119	119	120	119.5	2		
35	69	70	118	118	119	118.5	2		
40	69	69	118	118	118	118.0	2		
45	68	70	117	117	119	118.0	2		
50	67	69	116	116	118	117.0	2		
55	65	67	114	114	116	116.0	2		
60	65	65	114	114	114	114.0	2		
63	69	65	113	113	114	113.5	2		
								END 720214-04 - INFO	
								START 720214-05 - 1152	
								END 720214-05 - 1158	

PROPAGATION PATH LOSS  
DATE: 14 FEBRUARY 72 TEST RUN S/N: 720214-08:09  
PATH: WAYSIDE SITE NO. 19B TO ECOM HEXAGON

OPER. FREQ.: 229.5 MHz



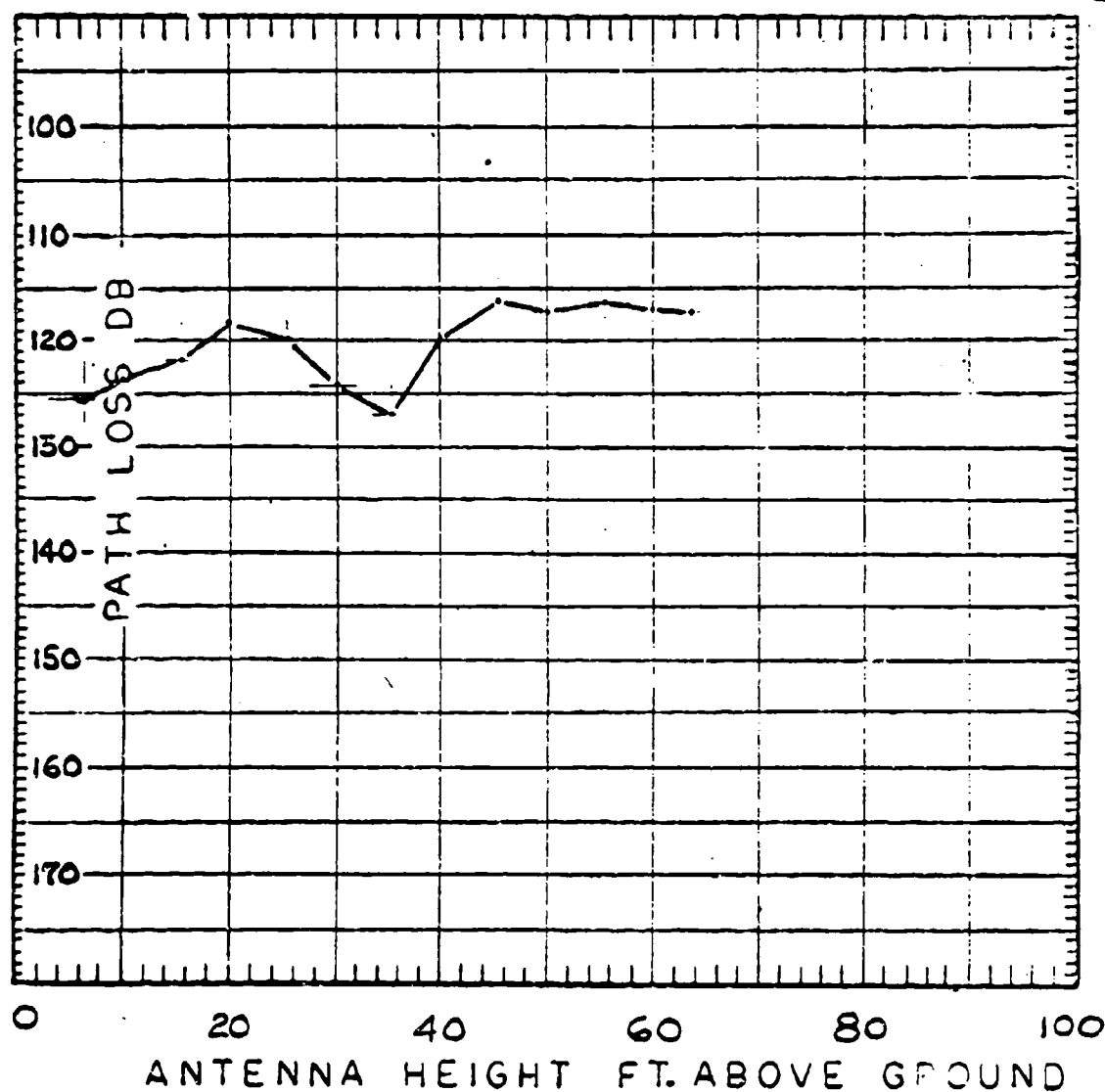
FREE  
SPACE  
LOSS  
89.2  
dB

TEST DATA SHEET									
OPER. FREQ. <u>229.5 MHz</u>		DATE: <u>14 FEB 72</u>		REC. SITE ANT. HT. <u>FT.</u>		START: <u>1350</u>			
SITE	LOCATION	XMT. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)	XMT. PWR.	+ANT. GAINS	-CABLE LOSSES
TRANSMITTER	WAYSIDE 19B	44 dBm	T-29	8.0	1.8		44.1	9.2	3.6
RECEIVER	ECCM HEXAGON		AT-197	1.2	1.8				
TOTAL ANT. GAIN (XMT + REC.)				8.0 + 1.2 = 9.2 dB					
TOTAL CABLE LOSS (XMT + REC.)				1.8 + 1.8 = 3.6 dB					
XMT. SITE HEIGHT ABOVE SEA LEVEL <u>140</u> FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL <u>170</u> FT.							
XMT. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS		
	TEST	TEST	TEST	TEST					
6	75	75	720214-08	720214-09	125	2	TRANSMITTING ANTENNA VERTICALLY POLARIZED		
10	72	73			125	2			
15	73	73			123.5	2			
20	74	73			123.0	2			
25	70	71			123.5	2			
30	69	70			120.5	2			
35	68	67			119.5	2			
40	66	67			117.5	2			
45	67	67			116.5	2			
50	64	66			112.0	2			
55	62	65			115.0	2	END 720214-08 -- 1354 START 720214-09 -- 1400 END 720214-09 -- 1406		
60	62	63			114.0	2			
63	61	62			112.5	2			
					111.5	2			



PROPAGATION PATH LOSS  
DATE : 14 FEBRUARY 72 TEST RUN S/N: 720214-06407  
PATH : WAYSIDE SITE No. 19B TO ECOM HEXAGON

OPER. FREQ. : 229.5 MHz



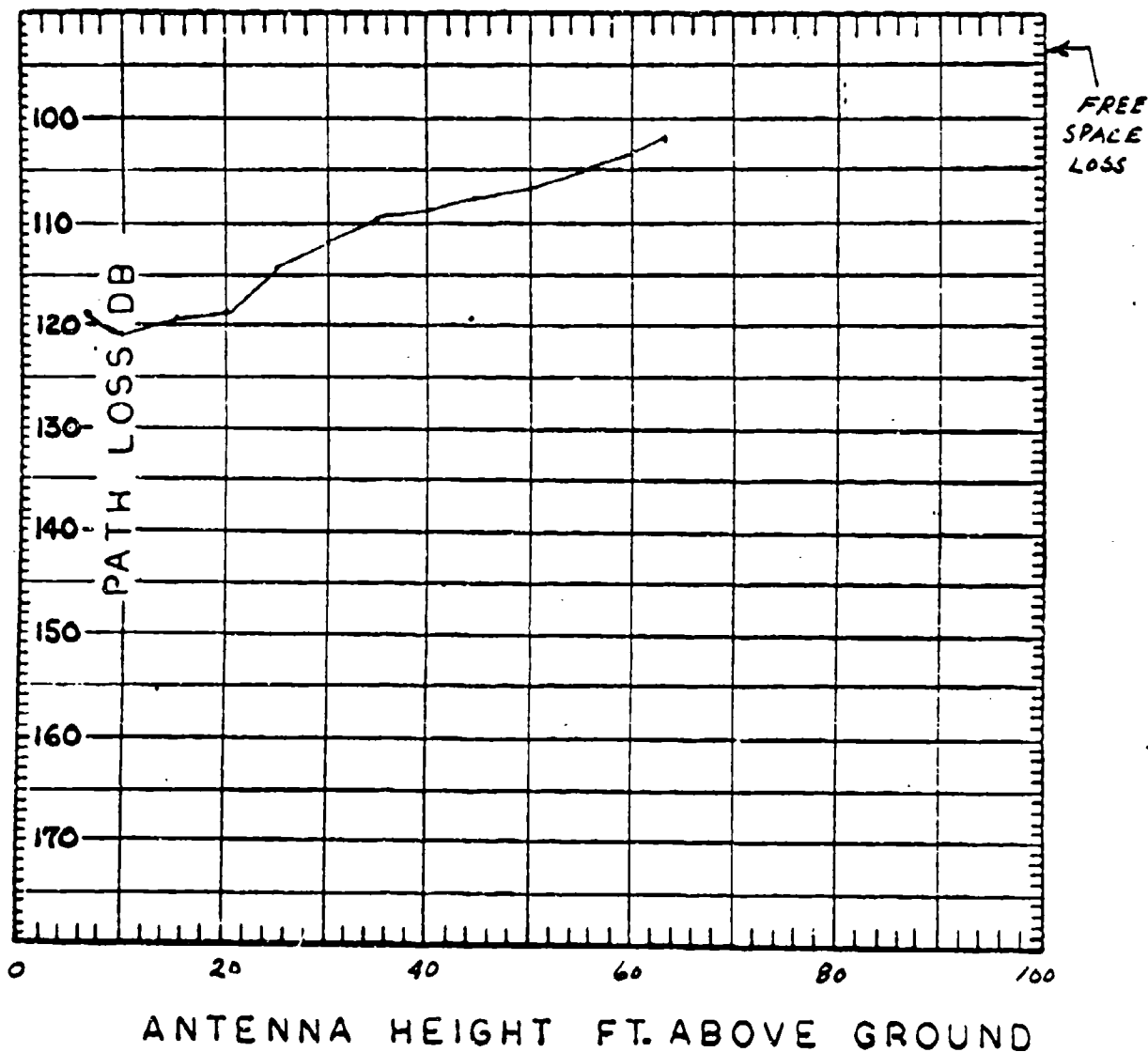
TEST DATA SHEET									
OPER. FREQ.		229.5 MHz		DATE: 14 FEBRUARY 1972		REC. SITE ANT. HT.		FT.	
START: 1327 HRS.									
SITE	LOCATION	XMTR. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)			
TRANSMITTER	WAYSIDE 19B	44 dBm	T-29	8.0	1.8	44.0			
RECEIVER	ECOM Hexagon		AT-197	1.2	1.8	9.2			
TOTAL ANT. GAIN (XMTR + REC.)		8.0 + 1.2 =		9.2 dB					
TOTAL CABLE LOSS (XMTR + REC.)		1.8 + 1.8 =		3.6 dB					
XMTR. SITE HEIGHT ABOVE SEA LEVEL		140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140 FT.			
XMTR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)	TEST	TEST	TEST	PATH LOSS (dB) = (ESP) - (RCVD. PWR.)	AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS	
6	75	720214-06	720214-07	720214-06	125	125.5	2	TRANSMITTING ANTENNA	
10	74			124	124	124.0	2	HORIZONTALLY POLARIZED	
15	72			122	122	122.0	2		
20	67			70	117	118.5	2		
25	70			70	120	120.0	2		
30	74			75	124	124.5	2		
35	77			77	127	127.0	2		
40	70			70	120	120.0	2		
45	67			66	117	116.5	2		
50	67			68	117	117.5	2		
55	66			67	116	116.5	2		
60	67			67	117	117.0	2		
65	67			68	117	117.5	2		
								END 720214-06 - 1332	
								START 720214-07 - 1338	
								END 720214-07 - 1344	

# PROPAGATION PATH LOSS

DATE: 16 FEBRUARY 72 TEST RUN S/N: 720216-01 F-02

PATH: WAYSIDE SITE NO. 198 TO ECOM HEXAGON

OPER. FREQ.: 371.4 MHz



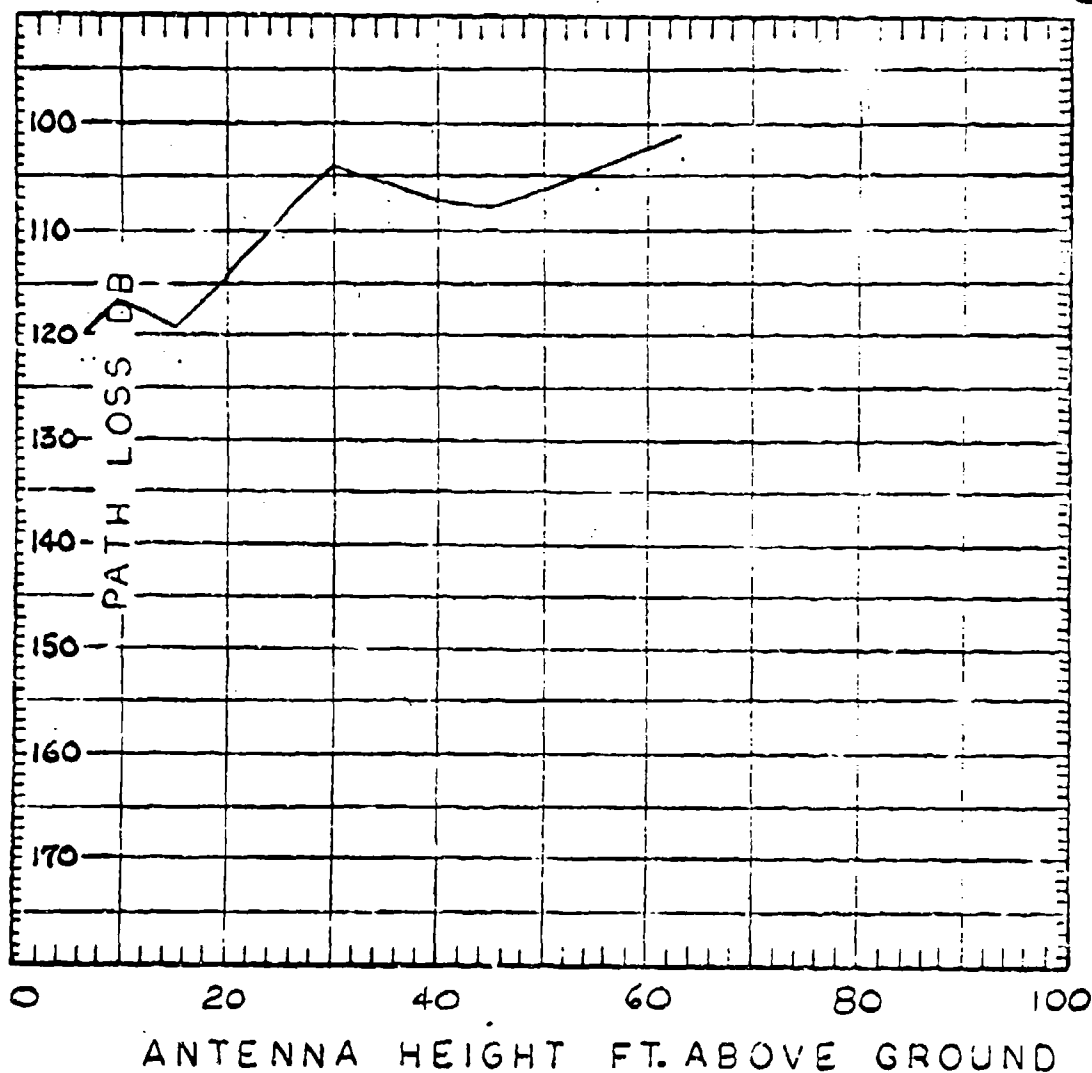
TEST DATA SHEET									
OPER. FREQ.		371.4 MHz		DATE: 16 FEBRUARY 1972		START: 0940 HRS.		FT.	
SITE		LOCATION		XMIT. PWR.		TYPE ANTENNA		ANT. GAIN (dB)	
TRANSMITTER		Wayside 198		44 dBm		EMCO 3101		6.10	
RECEIVER		ECOM Hexagon				AT-197		2.00	
TOTAL ANT. GAIN (XMITR + REC.)		6.10 + 2.00 =		8.10 dB					
TOTAL CABLE LOSS (XMITR + REC.)		2.3 + 2.3 =		4.60 dB					
XMITR. SITE HEIGHT ABOVE SEA LEVEL		140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140 FT.			
XMITR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMPL	REMARKS		
	TEST	TEST	720216-01	720216-02					
6	71	70	119	118	118.5	2			
10	74	73	122	121	121.5	2			
15	70	72	118	120	119.0	2			
20	69	71	117	119	118.0	2			
25	66	67	114	115	114.5	2			
30	64	64	112	112	112.0	2			
35	61	62	109	110	109.5	2			
40	60	61	108	109	108.5	2			
45	59	60	107	108	107.5	2			
50	58	58	106	106	106.5	2			
55	57	57	105	105	105.0	2			
60	55	55	103	103	103.0	2			
63	54	54	102	102	102.0	2			
							END 720216-01 - 0943		
							START 720216-02 - 0950		
							END 720216-02 - 0955		

# PROPAGATION PATH LOSS

DATE : 16 FEBRUARY 72 TEST RUN S/N : 720216-03 04F05

PATH : WAYSIDE SITE NO 19B TO ECOM HEXAGON

OPER. FREQ. : 229.5 MHz



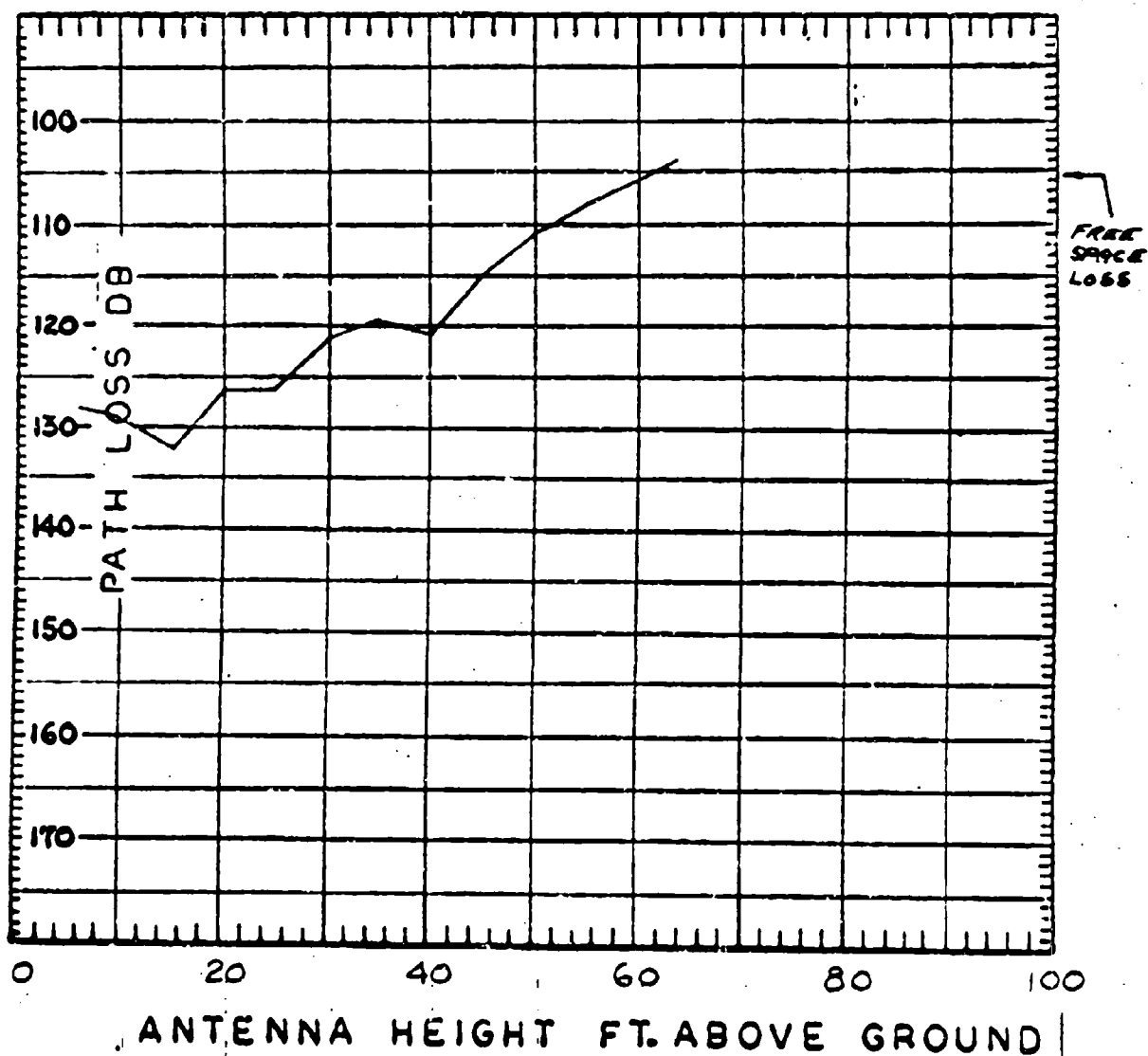
FREE  
SPACE  
LOSS  
89.2dB

TEST DATA SHEET									
OPER. FREQ.		229.5 MHz		DATE: 16 FEBRUARY 1972		REC. SITE ANT. HT.		FT.	
SITE		LOCATION		XMITR. PWR.		TYPE ANTENNA		ANT. GAIN (dB)	
TRANSMITTER		Wayside 19B		44.6W		EMCO 3101		-- 3.80	
RECEIVER		ECOM Hexagon				AT-197		1.20	
TOTAL ANT. GAIN (XMITR + REC.)		-3.80 + 1.20 =		-2.6		dB			
TOTAL CABLE LOSS (XMITR + REC.)		1.8 + 1.8 =		3.6		dB			
XMITR. SITE HEIGHT ABOVE SEA LEVEL		170		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		170	
XMITR. ANT. FT.		RCVD. PWR. (dBm)		TEST		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	
ANT. FT.		TEST		TEST		TEST		NO. OF SAMP	
GND (FT)		720216-03		720216-04		720216-05			
6	81	82	72	71	69	68	67	66	65
10	77	79	82	80	78	76	74	72	70
15	80	82	80	78	76	74	72	70	68
20	75	70	67	65	63	61	59	57	55
25	70	67	65	63	61	59	57	55	53
30	67	65	63	61	59	57	55	53	51
35	67	65	63	61	59	57	55	53	51
40	70	69	67	65	63	61	59	57	55
45	69	67	65	63	61	59	57	55	53
50	67	65	63	61	59	57	55	53	51
55	66	64	62	60	58	56	54	52	50
60	63	61	59	57	55	53	51	49	47
63	62	60	58	56	54	52	50	48	46
REMARKS									
END 720216-03-1013									
START 720216-04-1020									
END 720216-04-1025									
START 720216-05-1030									
END 720216-05-1035									

# PROPAGATION PATH LOSS

DATE : 16 FEBRUARY 72 TEST RUN S/N: 720216.06.07 F 08  
PATH: WAYSIDE SITE No. 19B TO ECOM HEXAGON

OPER. FREQ. : 1545 MHz



TEST DATA SHEET									
OPER. FREQ.		1545 MHZ		DATE: 16 FEB. 72		REC. SITE ANT. HT.		FT.	
SITE		LOCATION		TYPE ANTENNA		ANT. GAIN (dB)		CABLE LOSSES (dB)	
TRANSMITTER		WPKS-10E 19B		EMCO		-0.4		5.7	
RECEIVER		ECOM HEX.		EMCO		+0.3		1.2	
TOTAL ANT. GAIN (XMTR + REC.) -0.4 + 0.3 = -0.1 dB									
TOTAL CABLE LOSS (XMTR + REC.) 5.7 + 1.2 = 6.9 dB									
XMTR. SITE HEIGHT ABOVE SEA LEVEL 140 FT. RCVR. ANT. HEIGHT ABOVE SEA LEVEL 140 FT.									
ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMPL	REMARKS		
	TEST	TEST	TEST	TEST					
6	720216.06	720216.07	720216.07	720216.08	127	128.0			
10	90	92	127	128	128.0	3			
15	93	93	130	127	129.0	3			
20	97	97	134	127	132.5	3			
25	87	90	127	127	126.0	3			
30	92	87	124	125	126.0	3			
35	83	85	120	121	121.0	3			
40	82	83	119	119	119.3	3			
45	85	83	120	120	121.7	3			
50	80	76	117	115	115.0	3			
55	75	74	112	110	111.0	3			
60	73	70	110	108	108.5	3			
63	68	67	107	106	106.3	3			
		67	104	104	104.3	3			
							END 720216.06 - 1130		
							START 720216.07 - 1137		
							END 720216.07 - 1137		
							START 720216.08 - 1143		
							END 720216.08 - 1143		

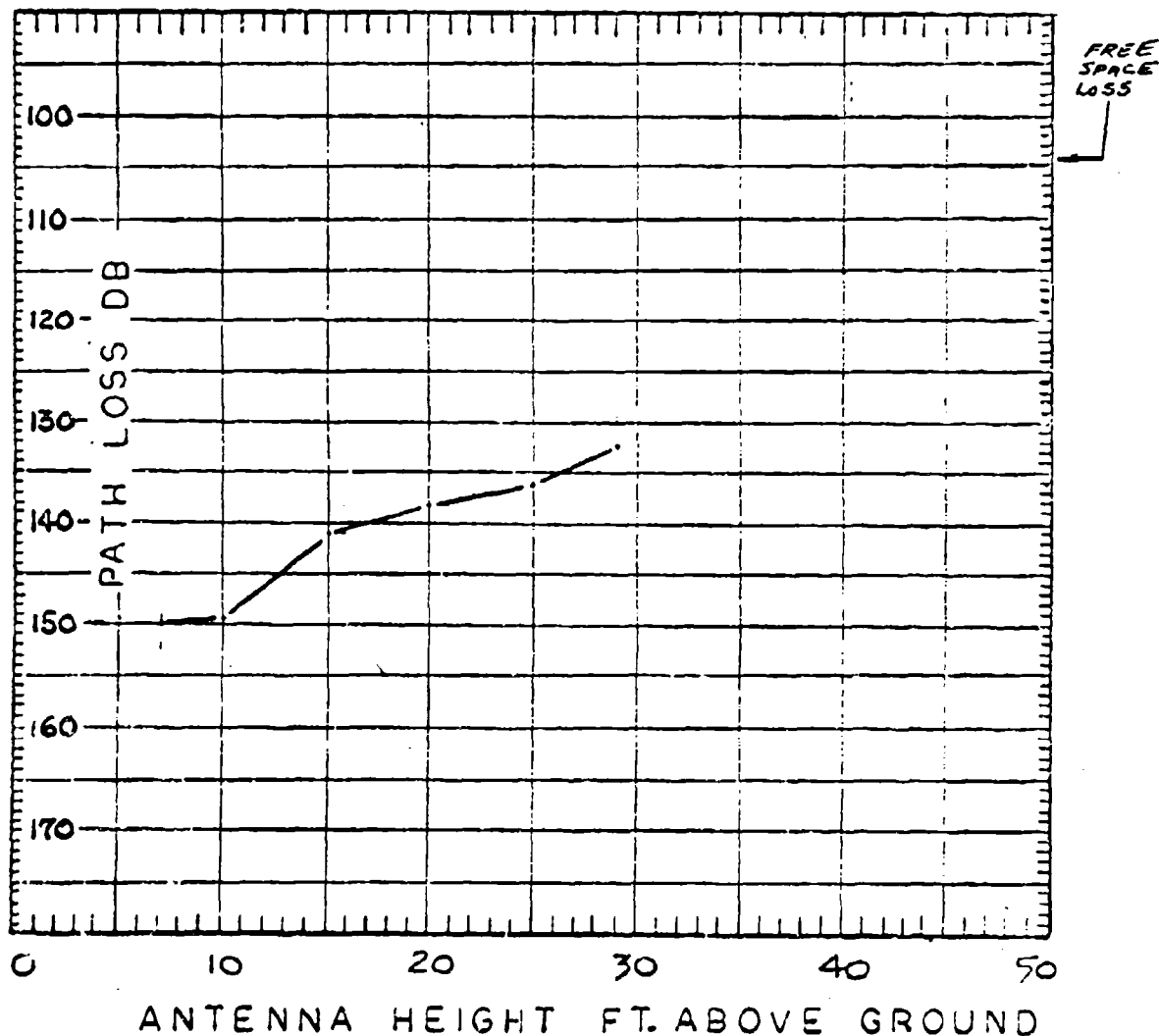


# PROPAGATION PATH LOSS

DATE : 17 FEBRUARY 72 TEST RUN S/N: 720217-02, 03 & 04

PATH : WAYSIDE SITE NO. 9 TO ECOM HEXAGON

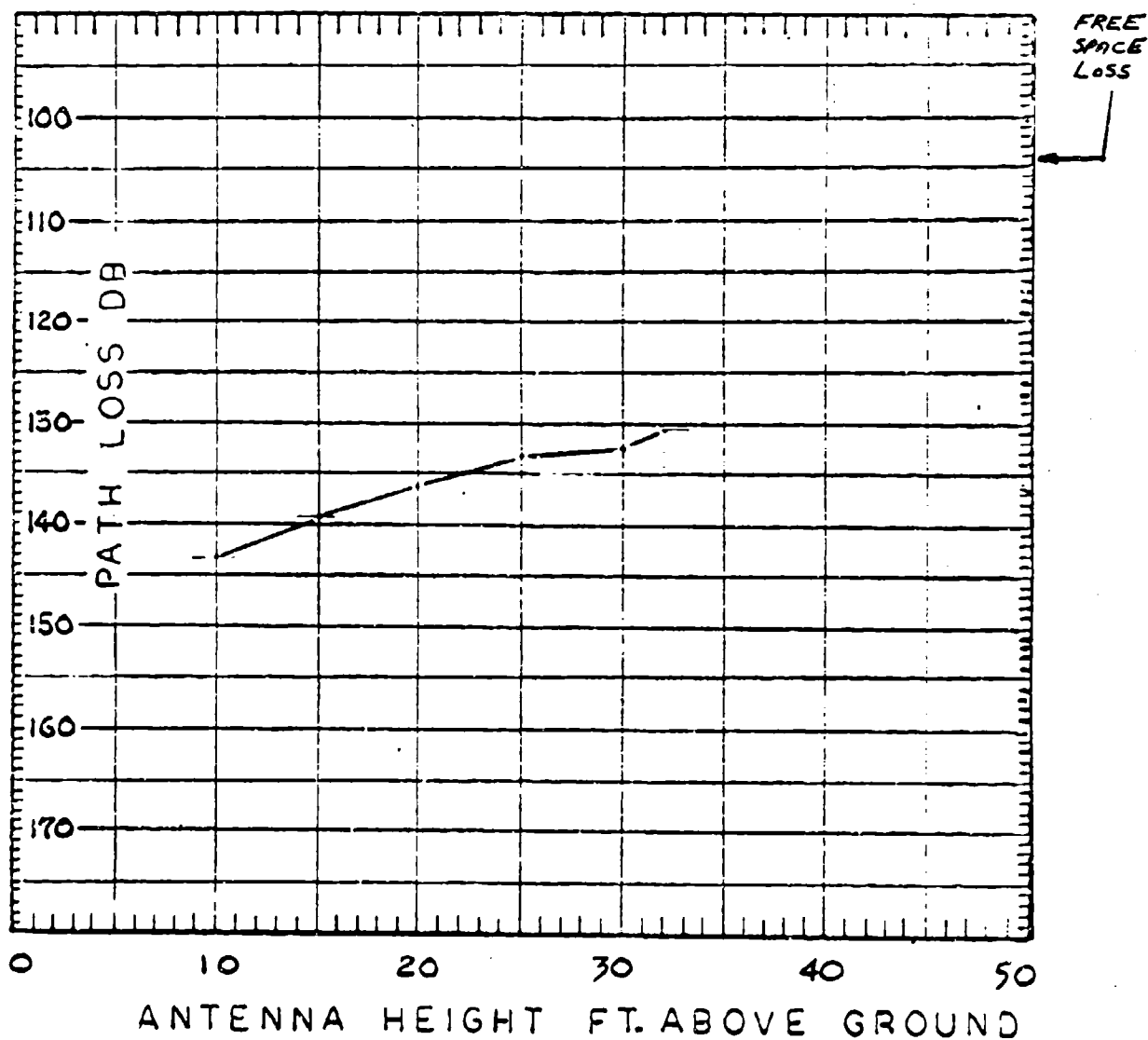
OPER. FREQ. : 1545 MHz



TEST DATA SHEET									
OPER. FREQ. 1545 MHz		DATE: 17 FEBRUARY 1972		REC. SITE ANT. HT. FT.		START: 1115 HRS.			
SITE	LOCATION	XMTR. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)			
TRANSMITTER	WAYSIDE 9	44 dBm	REL. HORN	14.4	5.7	XMTR. PWR. 44.0			
RECEIVER	ECOM HEXAGON		ANDREW BICONICAL	0.3	1.2	+ANT. GAINS 14.7			
TOTAL ANT. GAIN (XMTR + REC.)		14.4 + 0.3 =		14.7 dB					
TOTAL CABLE LOSS (XMTR + REC.)		5.7 + 1.2 =		6.9 dB					
XMTR. SITE HEIGHT ABOVE SEA LEVEL		140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		145 FT.			
XMTR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS		
	TEST	TEST	720217-02	720217-03				720217-04	
29	81	80	133	132	133	6	RUN 720217-01 DISCONTINUED		
25	84	85	136	136	137	6			
20	88	87	140	139	139	6			
15	92	90	142	142	140	6			
10	98	97	150	149	149	6			
7	97	98	149	151	150	3			
10	93	94	145	146	149				END 720217-02 - 1125
15	85	88	140	140	142				START 720217-03 - 1129
20	84	87	136	139	138				END 720217-03 - 1137
25	83	86	135	138	136				START 720217-04 - 1347
29	80	80	132	133	132				END 720217-04 - 1357

PROPAGATION PATH LOSS  
DATE : 17 FEBRUARY 72 TEST RUN S/N: 720217-05406  
PATH: WAYSIDE SITE NO. 9 TO ECOM HEXAGON

OPER. FREQ. : 1545 MHz



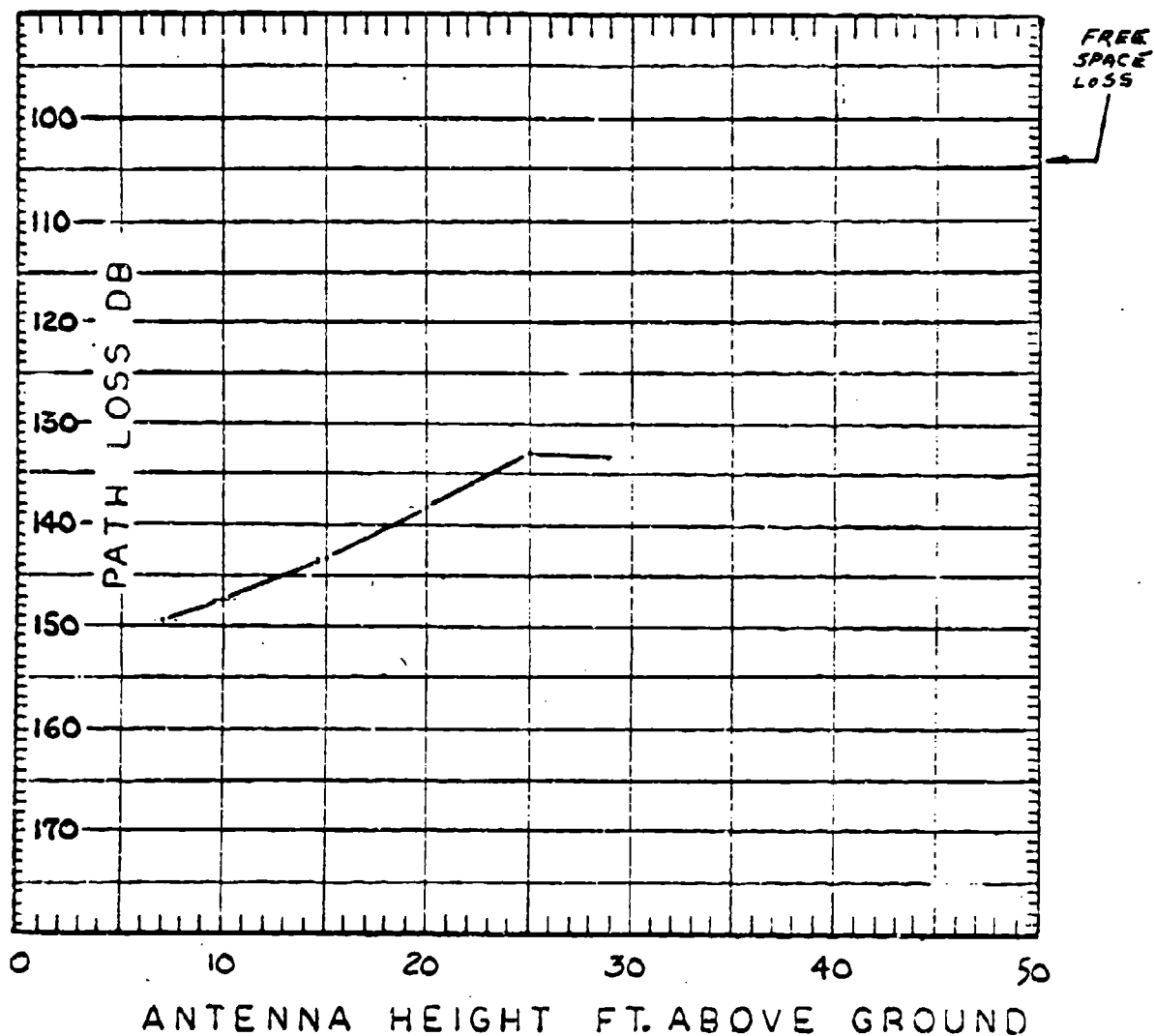


PROPAGATION PATH LOSS

DATE: 18 FEBRUARY 72 TEST RUN S/N: 720218-01402

PATH: WAYSIDE SITE NO. 9 TO ECOM HEXAGON

OPER. FREQ.: 1545 MHz



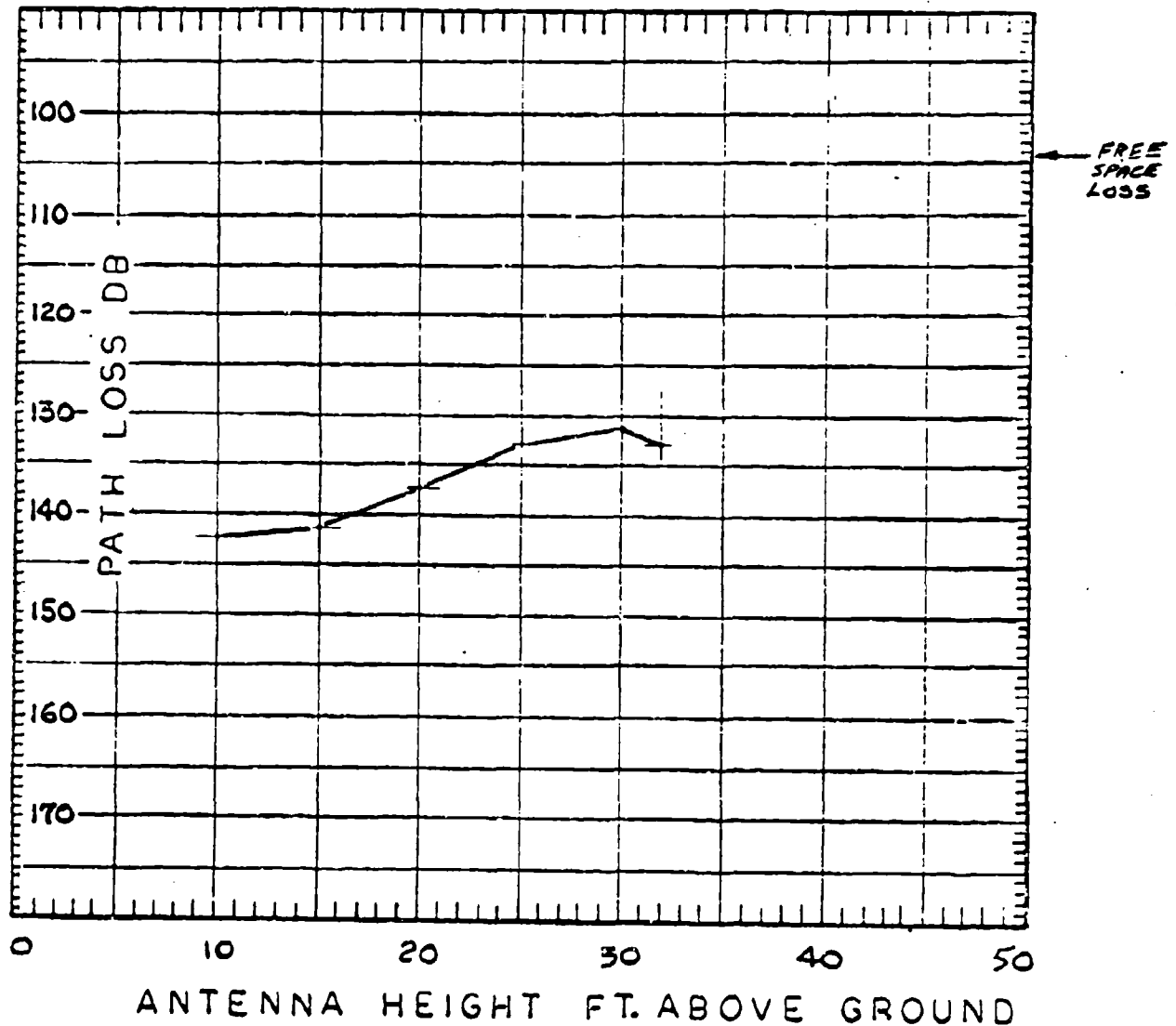
TEST DATA SHEET									
OPER. FREQ. 1545 MHz		DATE: 18 FEBRUARY 1972		REC. SITE ANT. HT. _____ FT.		START: 0955		H. _____	
SITE	LOCATION	XMTR. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)			
TRANSMITTER	WAYSIDE 9	44 dBm	REL HORN	14.4	5.7	XMTR. PWR. 44.0			
RECEIVER	ECOM HEXAGON		ANDREW BICONICAL	0.3	1.2	+ANT. GAINS 14.7			
TOTAL ANT. GAIN (XMTR + REC.)		14.4 + 0.3 = 14.7		dB		-CABLE LOSSES 6.9			
TOT. - CABLE LOSS (XMTR + REC.)		5.7 + 1.2 = 6.9		dB		=ESP = 51.8	52		
XMTR. SITE HEIGHT ABOVE SEA LEVEL 140		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL 145	FT.				
XMTR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS		
	TEST	TEST	TEST	TEST					
7	720218-01	720218-02	148	151	149.8	4			
10	93	98	145	150	147.5	4			
15	89	93	141	145	143.3	4			
20	86	87	138	139	138.5	4			
25	81	81	133	133	133.0	4			
29	81	82	133	134	133.5	4			
25	81	81	133	133					
20	86	87	138	139					
15	91	92	143	144					
10	95	96	147	148					
7	98	98	150	150					
							END 720218-01 - 1009		
							START 720218-02 - 1014		
							END 720218-02 - 1022		

# PROPAGATION PATH LOSS

DATE : 18 FEBRUARY 72 TEST RUN S/N: 720218-03104

PATH : WAYSIDE SITE NO. 9 TO ECOM HEXAGON

OPER. FREQ. : 1545 MHZ

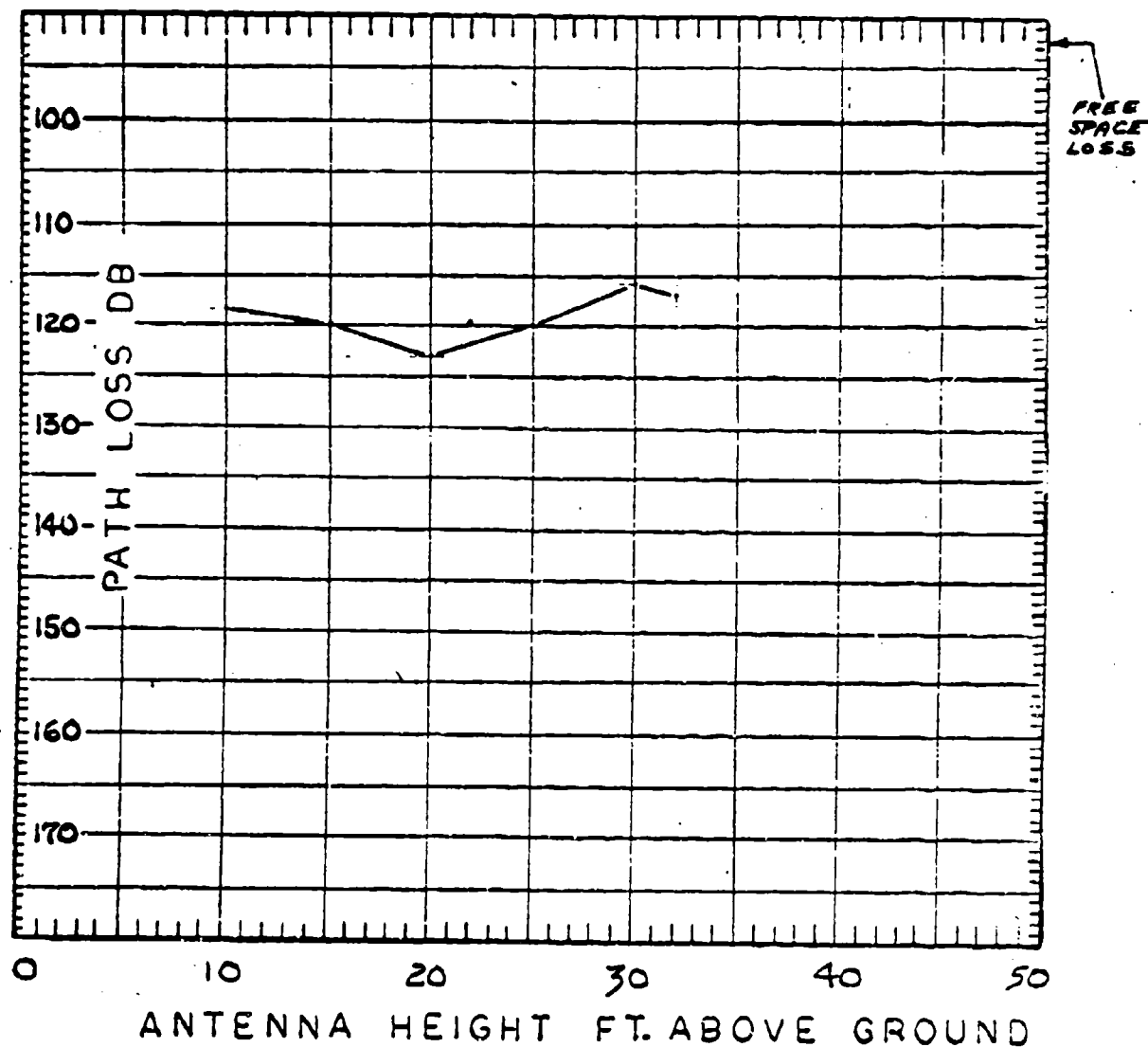


TEST DATA SHEET									
OPER. FREQ. <u>1545 MHz</u>		REC. SITE ANT. HT. <u>FT.</u>		DATE: <u>18 FEBRUARY 1972</u>		START: <u>1035 HRS</u>			
SITE	LOCATION	XMT. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)			
TRANSMITTER	WAXSIDE 9	44 dBm	ANDREWS DISCONE	2.5	5.7	XMT. PWR. 44.0			
RECEIVER	ECONOM HEXAGON		ANDREWS BICONICAL	0.3	1.2	+ANT. GAINS 2.8			
TOTAL ANT. GAIN (XMT + REC.)		2.5 + 0.3 =		2.8 dB		-CABLE LOSSES 5.7			
TOTAL CABLE LOSS (XMT + REC.)		5.7 + 1.2 =		6.9 dB		=ESP = 34.9 USE 40			
XMT. SITE HEIGHT ABOVE SEA LEVEL		140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		145 FT.			
XMT. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS		
	TEST	TEST	720218-03	720218-04					
10	104	102	144	142	142.3	4			
15	102	100	142	140	141.3	4			
20	97	97	137	137	137.5	4			
25	94	93	134	133	133.0	4			
30	93	92	133	132	131.5	4			
32	93	93	133	133	133.0	2			
30	90	90	130	130					
25	92	93	132	133					
20	98	98	138	138					
15	97	106	137	146					
10	100	103	140	143					
							END 720218-03 - 1043		
							START 720218-04 - 1047		
							END 720218-04 - 1055		



PROPAGATION PATH LOSS  
DATE: 18 FEBRUARY 72 TEST RUN S/N: 720218-05406  
PATH: WAYSIDE SITE NO. 9 TO ECOM HEXAGON

OPER. FREQ.: 371.4 MHz



DATE: 18 FEBRUARY 1972

OPER	FREQ	371.4 MHz	REC. SITE	ANT. HT.	FT.	START: 1/29	HRS.

START: 1/29 HRS.

13.

REC. SITE ANT. HT.

OPER	371.4	MFZ
------	-------	-----

SITE	LOCATION	XHTR RUD	TYPE ANTENNA	ANT GAIN	CABLE LOSSES	EQUIV. SYS. PWR. (ESP)
1	1					
2	2					
3	3					
4	4					
5	5					
6	6					
7	7					
8	8					
9	9					
10	10					
11	11					
12	12					
13	13					
14	14					
15	15					
16	16					
17	17					
18	18					
19	19					
20	20					
21	21					
22	22					
23	23					
24	24					
25	25					
26	26					
27	27					
28	28					
29	29					
30	30					
31	31					
32	32					
33	33					
34	34					
35	35					
36	36					
37	37					
38	38					
39	39					
40	40					
41	41					
42	42					
43	43					
44	44					
45	45					
46	46					
47	47					
48	48					
49	49					
50	50					
51	51					
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64	64					
65	65					
66	66					
67	67					
68	68					
69	69					
70	70					
71	71					
72	72					
73	73					
74	74					
75	75					
76	76					
77	77					
78	78					
79	79					
80	80					
81	81					
82	82					
83	83					
84	84					

TRANSMITTER	WAYSIDE	44' 6M	AT-197	2.0	2.3	XMTR. PWR.
	9					14.0

RECEIVER	ECOM HEXAGON	AT-197	2.0	2.3	+ANT	GAUSS	40

TOTAL ANT. GAIN (XMITR + REC.)  $2.0 + 2.0 = 4.0$  dB

TOTAL CABLE LOSS (XNTR + REC.)  $2.3 + 2.3 = 4.6$  dB

STATION	INSTR.	SITE HEIGHT ABOVE SEA LEVEL	140 FT.	RCVR. ANT. HEIGHT ABOVE SEA LEVEL	140 FT.
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
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81					
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91					
92					
93					
94					
95					
96					
97					
98					
99					
100					

TXMT.R.	RCVD. PWR. (dBm)	PATH LOSS (dB) =	AVG.
1			
2			
3			
4			
5			
6			
7			
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13			
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89			
90			
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92			
93			
94			
95			
96			
97			
98			
99			
100			

REMARKS.	OF	PAIR.	OF
BOVE	72	72	72
BOVE	72	72	72

(1) 0	50-815	90-815	50-815	90-815	(BP)	SAME
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10	11	16	120	119	118.2	4
10	11	16	120	119	118.2	4

20	80	123	124	123.0	4
20	81	123	124	123.0	4

42	17	120	120	120.0	4
43	17	120	120	120.0	4
44	17	120	120	120.0	4
45	17	120	120	120.0	4
46	17	120	120	120.0	4
47	17	120	120	120.0	4
48	17	120	120	120.0	4
49	17	120	120	120.0	4
50	17	120	120	120.0	4
51	17	120	120	120.0	4
52	17	120	120	120.0	4
53	17	120	120	120.0	4
54	17	120	120	120.0	4
55	17	120	120	120.0	4
56	17	120	120	120.0	4
57	17	120	120	120.0	4
58	17	120	120	120.0	4
59	17	120	120	120.0	4
60	17	120	120	120.0	4
61	17	120	120	120.0	4
62	17	120	120	120.0	4
63	17	120	120	120.0	4
64	17	120	120	120.0	4
65	17	120	120	120.0	4
66	17	120	120	120.0	4
67	17	120	120	120.0	4
68	17	120	120	120.0	4
69	17	120	120	120.0	4
70	17	120	120	120.0	4
71	17	120	120	120.0	4
72	17	120	120	120.0	4
73	17	120	120	120.0	4
74	17	120	120	120.0	4
75	17	120	120	120.0	4
76	17	120	120	120.0	4
77	17	120	120	120.0	4
78	17	120	120	120.0	4
79	17	120	120	120.0	4
80	17	120	120	120.0	4
81	17	120	120	120.0	4
82	17	120	120	120.0	4
83	17	120	120	120.0	4
84	17	120	120	120.0	4
85	17	120	120	120.0	4
86	17	120	120	120.0	4
87	17	120	120	120.0	4
88	17	120	120	120.0	4
89	17	120	120	120.0	4
90	17	120	120	120.0	4
91	17	120	120	120.0	4
92	17	120	120	120.0	4
93	17	120	120	120.0	4
94	17	120	120	120.0	4
95	17	120	120	120.0	4
96	17	120	120	120.0	4
97	17	120	120	120.0	4
98	17	120	120	120.0	4
99	17	120	120	120.0	4
100	17	120	120	120.0	4

32	75	73	118	116	117.0	2
32	75	73	118	116	117.0	2

[illegible]

25	77	116	112	120
25	77	120	120	120

20	79	80	122	123
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[illegible]

SMER 720218-06 -- 1130

END 720318-06 90-11027 2411-1196

[illegible][illegible][illegible][illegible]

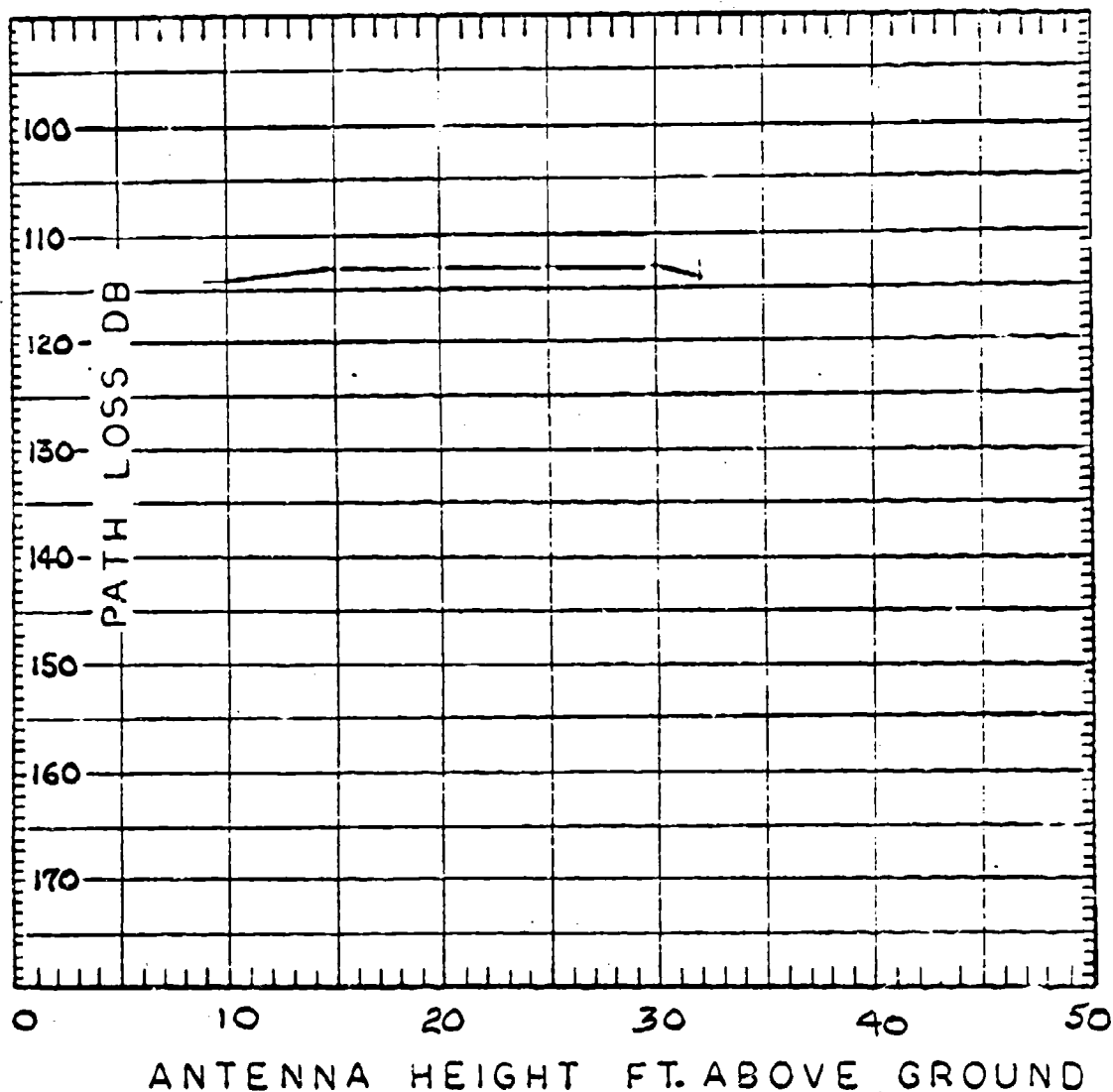
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# PROPAGATION PATH LOSS

DATE : 18 FEBRUARY 72 TEST RUN S/N: 720218-0708609

PATH: WAYSIDE SITE NO. 9 TO ECOM HEXAGON

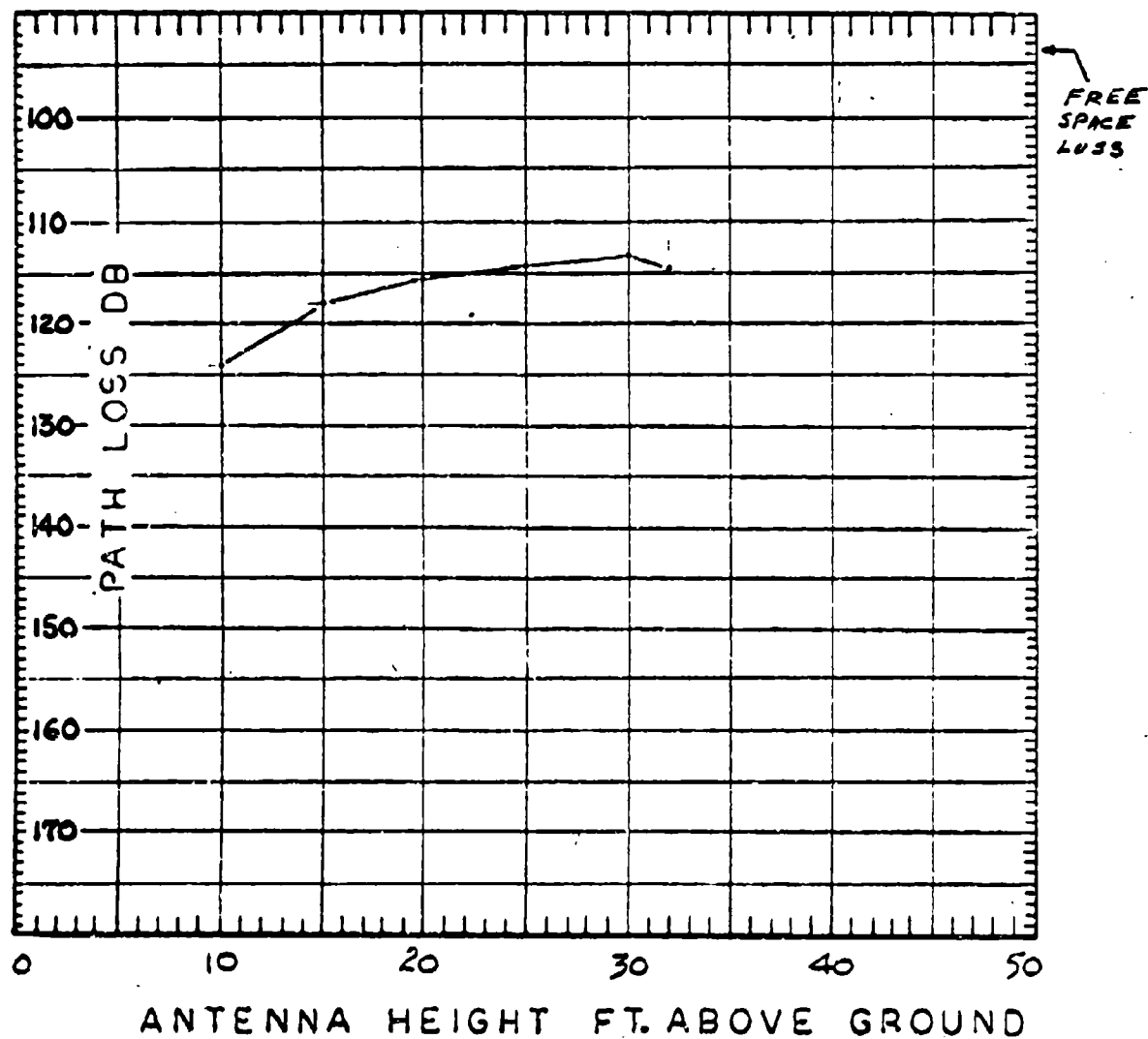
OPER. FREQ. : 229.5 MHz



TEST DATA SHEET										
OPER. FREQ. 229.5 MHz		DATE: 18 FEBRUARY 1972		START: 1308 HRS.						
SITE		LOCATION		REC. SITE ANT. HT. FT.						
TRANSMITTER		WAYSIDE 9		XMR. PWR. 44 dBm	TYPE ANTENNA AT-197	ANT. GAIN (dB) 1.2	CABLE LOSSES (dB) 1.8	EQUIV. SYS. PWR. (ESP) 44.0		
RECEIVER		ECOM HEXAGON			AT-197	1.2	1.8	+ ANT. GAINS 2.4		
TOTAL ANT. GAIN (XMR + REC.)		1.2 + 1.2 = 2.4		dB						
TOTAL CABLE LOSS (XMR + REC.)		1.8 + 1.8 = 3.6		dB						
XMR. SITE HEIGHT ABOVE SEA LEVEL 140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL 140 FT.								
XMR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS			
	TEST	TEST	720218-07	720218-08						
10	72	70	70	71	115	113	114	114.0	6	
15	71	70	70	70	114	113	113	113.1	6	
20	71	70	70	70	114	113	113	113.1	6	
25	71	70	70	70	114	113	113	113.1	6	
30	71	70	70	70	114	113	113	113.1	6	
32	72	71	71	70	115	114	113	114.0	3	
30	70	70	70	70	113	113	113			
25	70	70	70	70	113	113	113			
20	70	72	70	70	113	113	113			
15	70	70	70	70	113	113	113			
10	71	71	71	71	114	114	114			
END 720218-07 -- 1313										
START 720218-08 -- 1320										
END 720218-08 -- 1325										
START 720218-09 -- ?										
END 720218-09										

PROPAGATION PATH LOSS  
DATE: 10 MARCH 72 TEST RUN SN: 720310.01402  
PATH: WAYSIDE SITE NO. 19 TO ECOM HEXAGON

OPER. FREQ.: 371.4 MHz

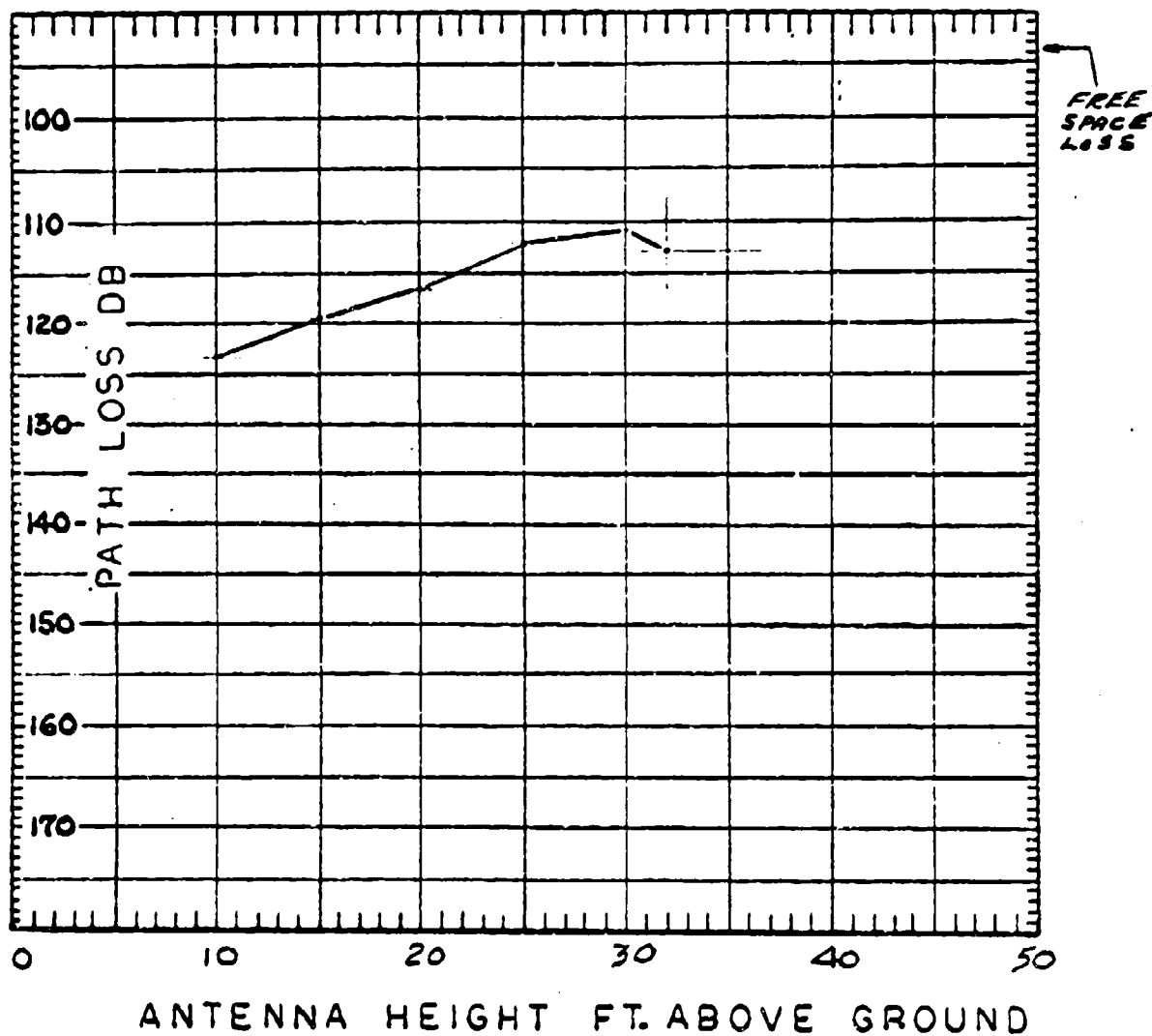


NOTE: AT-197  
ANTENNA



PROPAGATION PATH LOSS  
DATE : 10 MARCH 72 TEST RUN S/N: 720310.03.04  
PATH: WAYSIDE SITE NO. 19 TO ECOM HEXAGON

OPER. FREQ. : 371.4 MHz



NOTE: AT-197  
ANTENNA

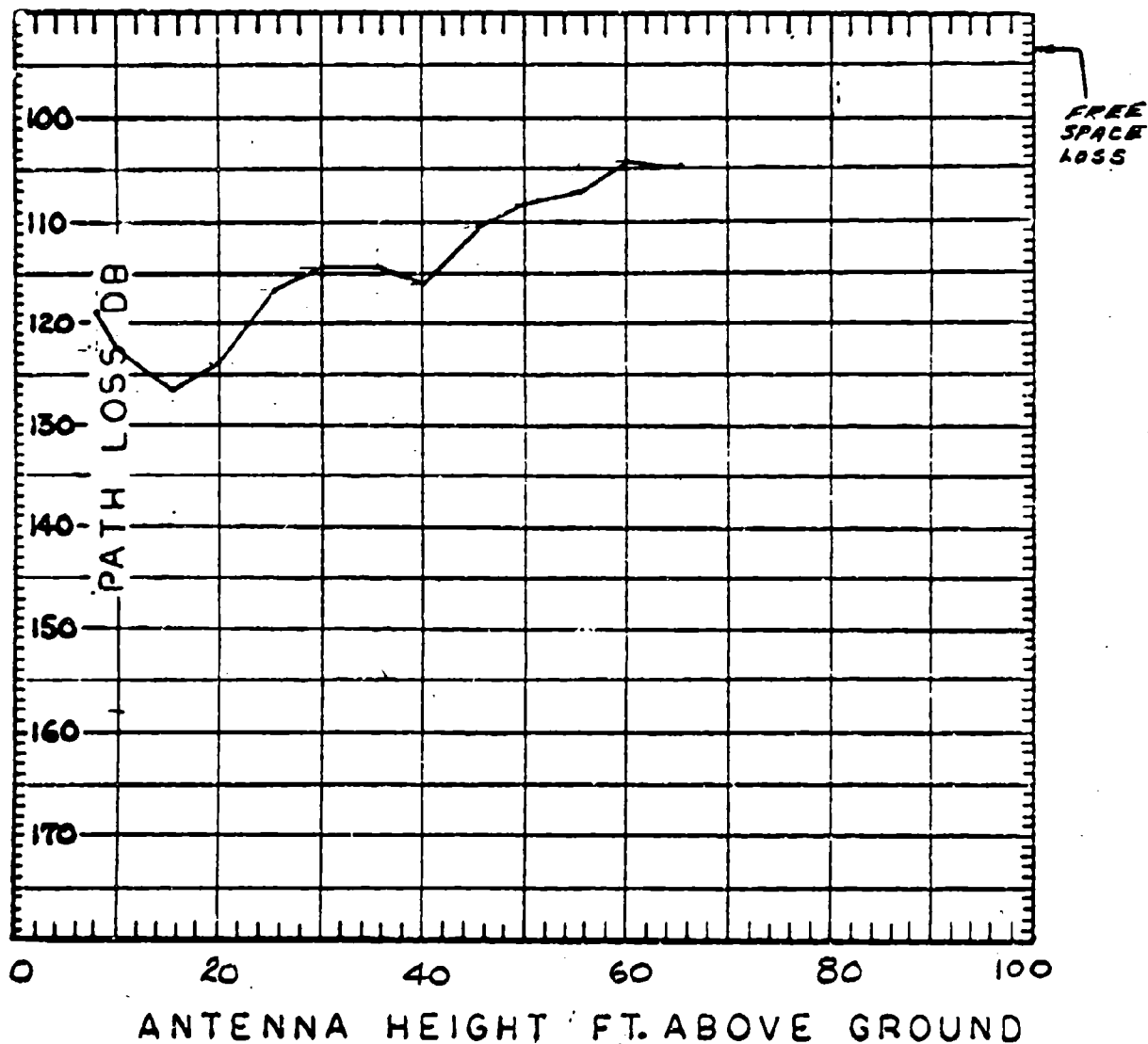




# PROPAGATION PATH LOSS

DATE : 10 MARCH 72 TEST RUN SN: 720310.05406  
PATH: WAYSIDE SITE NO. 19B TO ECOM HEXAGON

OPER. FREQ. : 371.4 MHz



NOTE: AT-197  
ANTENNA

TEST DATA SHEET									
OPER. FREQ.		371.4 MHz		REC. SITE ANT. HT.		FT.		DATE: 10 NOV 1972	
SITE		LOCATION		XMT. PWR.		TYPE ANTENNA		ANT. GAIN (dB)	
TRANSMITTER		WILSON 198		44.6W		AT-197		2.0	
RECEIVER		ECON H/X.				AT-197		2.0	
TOTAL ANT. GAIN (XMT + REC.)		2.0 + 2.0 = 4.0		dB				CABLE LOSSES (dB)	
TOTAL CABLE LOSS (XMT + REC.)		2.3 + 2.3 = 4.6		dB				EQUIV. SYS. PWR. (ESP)	
XMT. SITE HEIGHT ABOVE SEA LEVEL		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		FT.		XMT. PWR.	
XMT. ANT. HT. ABOVE GND (FT)		RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)		NO. OF SAMP	
8		720310.05		720310.05		121		4	
10		75		118		119.0		4	
15		79		122		122.75		4	
20		83		126		126.75		4	
25		81		124		124.0		4	
30		73		116		116.5		4	
35		72		115		114.75		4	
40		70		113		114.75		4	
45		75		119		116.0		4	
50		67		111		110.25		4	
55		66		109		108.5		4	
60		65		107		107.75		4	
65		62		104		104.75		4	
70		62		105		105.00		2	
75		62		105					
80		65		108					
85		65		108					
90		67		108					
95		74		110					
100		70		113					
105		71		114					

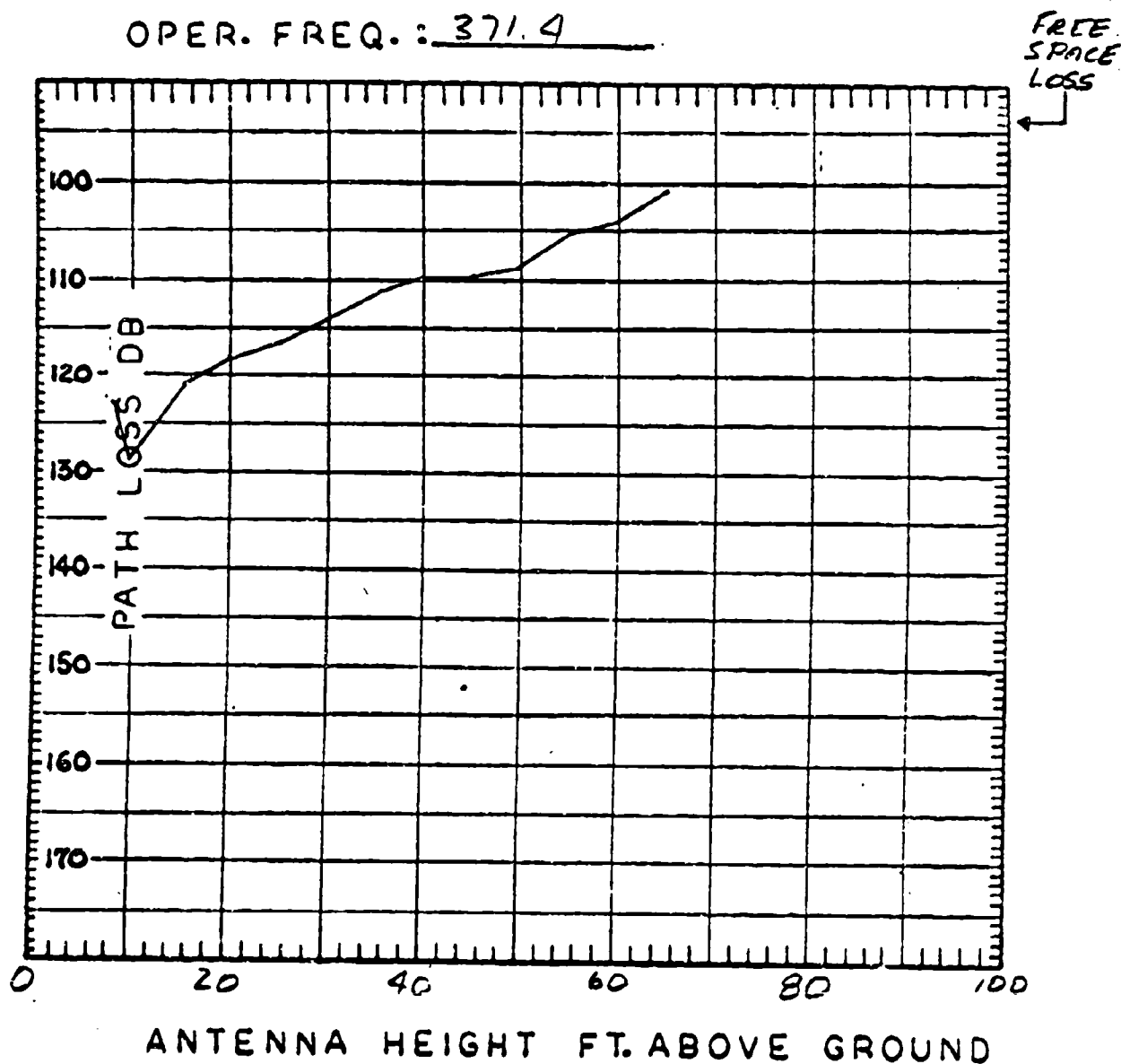
[illegible]

# PROPAGATION PATH LOSS

DATE: 10 MARCH 72 TEST RUN SN: 720310.07108

PATH: WAYSIDE SITE NO. 19B TO ECOM HEXAGON

OPER. FREQ.: 371.4



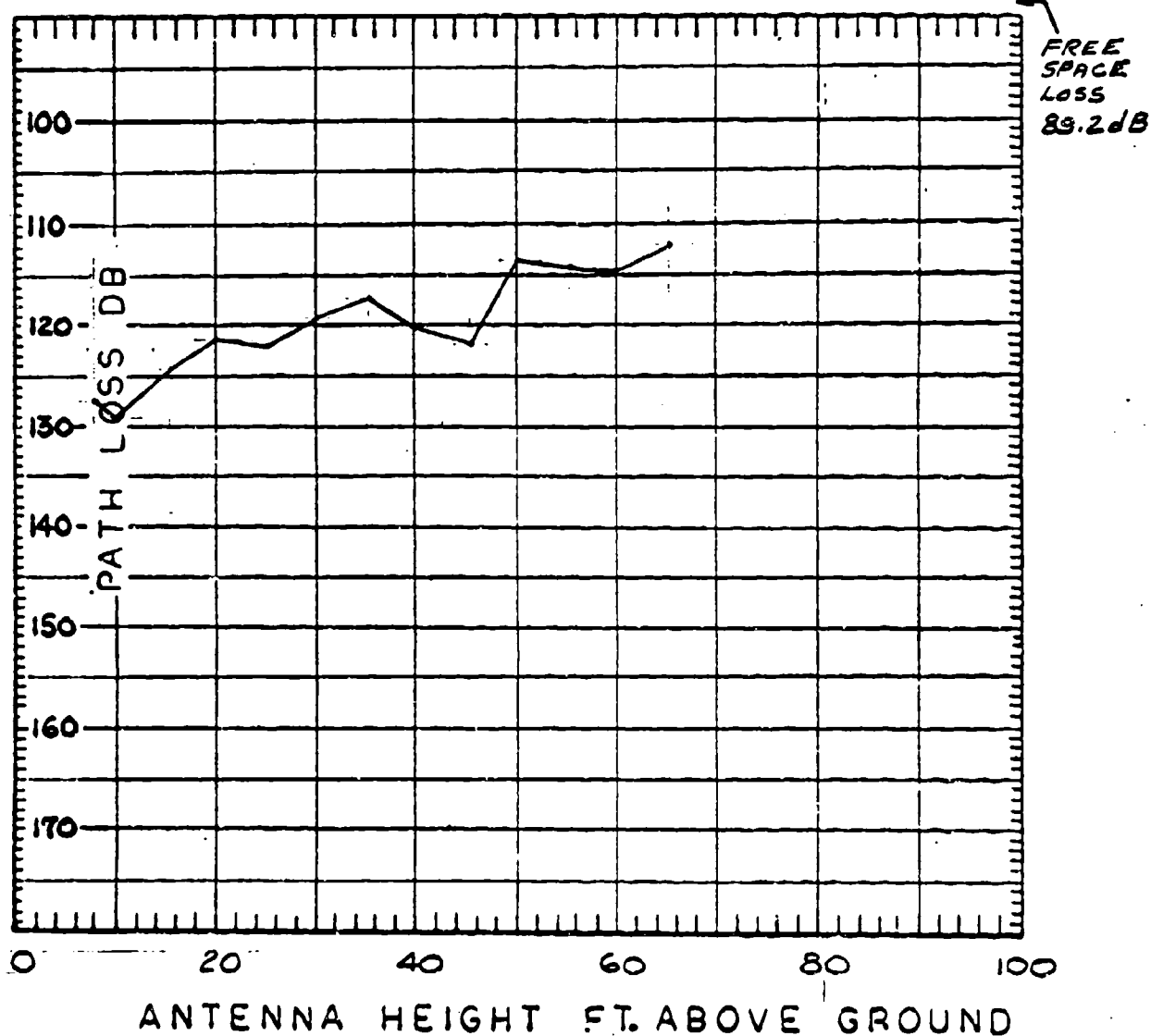
TEST DATA SHEET										DATE: 10 MARCH 1972	
OPER. FREQ. 371.4 MHz		REC. SITE ANT. HT.		FT.		START:		HRS.			
SITE	LOCATION	XMT. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)					
TRANSMITTER	Wayside RD	49 dBm	EMCO 3101	6.1	2.3	44					
RECEIVER	Ecom Hex		AT-197	2.0	2.3	8.1					
TOTAL ANT. GAIN (XMT + REC.)		6.1 + 2.0 = 8.1		dB							
TOTAL CABLE LOSS (XMT + REC.)		2.3 + 2.3 = 4.6		dB							
XMT. SITE HEIGHT ABOVE SEA LEVEL		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		FT.					
XMT. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)	TEST	TEST	TEST	PATH LOSS (dB) = (ESP) - (RCVD. PWR.)	AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS			
8	75	720310.07	720310.08	720310.09	123	124	123.75	4			
10	81		80		129	128	128.00	4			
15	77		73		125	121	121.75	4			
20	70		72		118	120	118.75	4			
25	68		69		116	117	116.50	4			
30	66		66		114	114	114.00	4			
35	63		63		111	111	111.25	4			
40	62		62		110	110	109.75	4			
45	62		61		110	109	109.75	4			
50	60		60		108	108	108.25	4			
55	59		58		107	106	105.25	4			
60	58		57		106	105	104.25	4			
65	57		56		99	104	101.50	2			
60	58		57		101	105					
55	59		58		102	106					
50	61		60		109	108					
45	62		60		110	108					
40	62		61		110	109					
35	64		63		112	111					
30	66		66		114	114					

TEST DATA SHEET						DATE: 10 MARCH 1972	
OPER. FREQ.		REC. SITE ANT. HT.		FT.		START:	
SITE		LOCATION		XNTR. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	EQUIV. SYS. PWR. (ESP)
TRANSMITTER		WING-IDE 19B		44 dBm	EMC03101	6.1	44
RECEIVER		ECOM HICX			A7-197	2.0	8.1
TOTAL ANT. GAIN (XNTR + REC.)				6.1 + 2.0 = 8.1		dB	- CABLE LOSSES 4.6
TOTAL CABLE LOSS (XNTR + REC.)				2.3 + 2.3 = 4.6		dB	= ESP = 47.5 USE 46
XNTR. SITE HEIGHT ABOVE SEA LEVEL		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		FT.	
XNTR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dbm)		PATH LOSS (dB) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS
	TEST	TEST	(ESP)	(RCVD. PWR.)			
25	7203.007	7203.008	7203.007	7203.008			
20	68	69	116	117			
15	70	71	118	119			
10	72	73	120	121			
8	71	78	124	126			
	77	75	125	123			

# PROPAGATION PATH LOSS

DATE: 10 MARCH 72 TEST RUN S/N: 720310.09; 10  
PATH: WAYSIDE SITE 19B TO ECOM HEXAGON

OPER. FREQ.: 229.5 MHz



NOTE: EMCO 3101 ANT.  
CIRCULAR POLARIZED

TEST DATA SHEET									
OPER. FREQ. <u>229.5 MHz</u>		DATE: <u>10 MARCH 72</u>		REC. SITE ANT. HT. <u>FT.</u>		START: <u>MRS.</u>			
SITE	LOCATION	XMT. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)			
TRANSMITTER	WYDSIDE 19B	4.4dBm	EMCO 3101	-3.8	1.8	XMT. PWR. 44			
RECEIVER	ECOM HEX.		AT-197	2.0	1.8	+ANT. GAINS -1.8			
TOTAL ANT. GAIN (XMT + REC.)		-3.8 + 2.0 = -1.8		dB		-CABLE LOSSES 3.6			
TOTAL CABLE LOSS (XMT + REC.)		1.8 + 1.8 = 3.6		dB		-ESP = 38.6 USE 39			
XMT. SITE HEIGHT ABOVE SEA LEVEL <u>FT.</u>		RCVR. ANT. HEIGHT ABOVE SEA LEVEL <u>FT.</u>							
XMT. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBH)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMPL	REMARKS		
	TEST	TEST	TEST	TEST					
8	72.310.09	72.310.10	12.3	13.2	121.25	4			
10	81	80	13.0	13.4	129.00	4			
15	87	80	12.3	11.9	124.50	4			
20	85	81	12.4	12.2	121.75	4			
25	82	81	12.4	12.3	122.25	4			
30	80	81	11.9	12.0	119.75	4			
35	79	80	11.8	11.6	117.25	4			
40	81	80	12.0	11.9	120.50	4			
45	85	83	12.4	12.1	122.00	4			
5	75	75	11.4	11.4	113.75	4			
5	75	75	11.4	11.4	114.00	4			
5	76	73	11.5	11.4	114.75	4			
60	76	76	11.2	11.2	112.00	2			
55	75	75	11.5	11.5					
50	75	74	11.4	11.4					
45	84	81	12.3	12.0					
40	81	81	12.3	12.0					
35	82	77	12.1	11.6					
30	82	80	12.1	11.9					



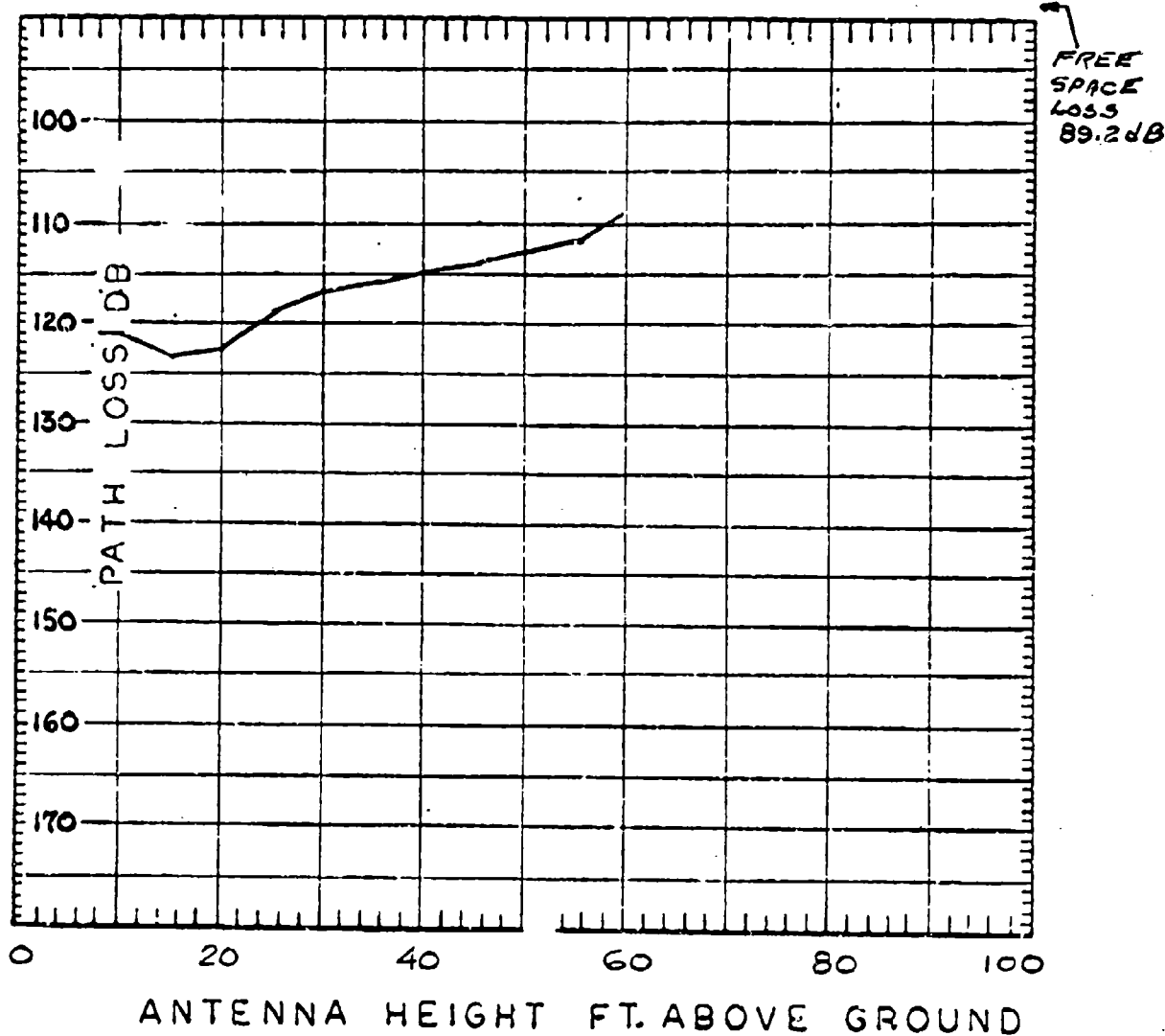
[illegible]

# PROPAGATION PATH LOSS

DATE : 10 MARCH 72 TEST RUN S/N: 720310.11

PATH: WAYSIDE SITE NO 19B TO ECCM HEXAGON

OPER. FREQ.: 229.5 MHz



NOTE: T-29 ANT.  
VERT. POLARIZED

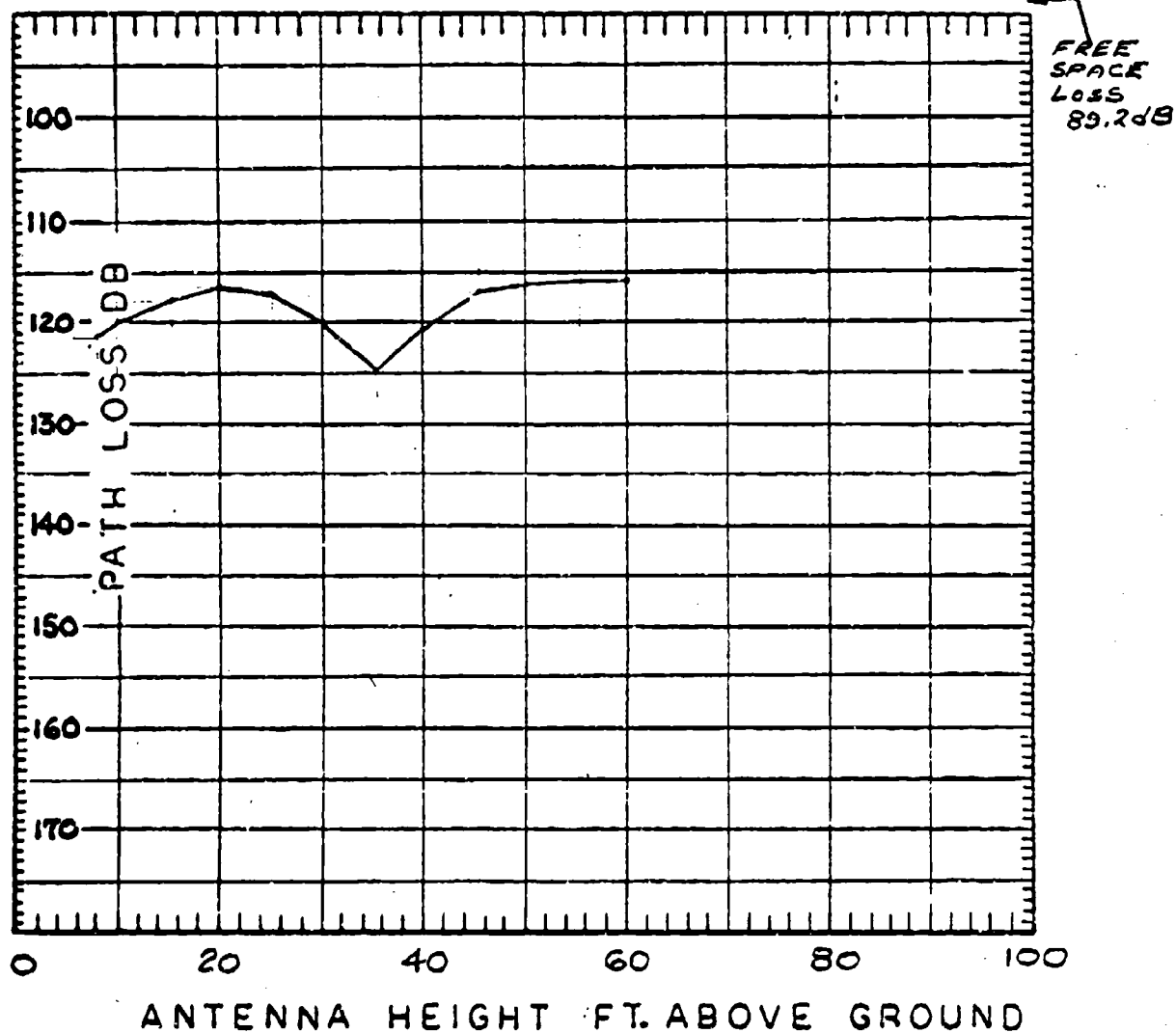
TEST DATA SHEET									
OPER. FREQ.		229.5 MHz		DATE: 10 MARCH 72		START: _____		HRS. _____	
SITE		LOCATION		REC. SITE ANT. HT. _____ FT.		ANT. GAIN (dB)		CABLE LOSSES (dB)	
TRANSMITTER		Wayside 19B		TYPE ANTENNA		ANT. GAIN (dB)		EQUIV. SYS. PWR. (ESP)	
RECEIVER		ECOM Hex.		PWR. 44dBm		729 VERT.		XMTR. PWR. 44	
TOTAL ANT. GAIN (XMTR + REC.)		8.0 + 1.2 = 9.2		ANT. GAIN (dB)		1.8		+ANT. GAINS 9.2	
TOTAL CABLE LOSS (XMTR + REC.)		1.8 + 1.8 = 3.6		RCVR. ANT. HEIGHT ABOVE SEA LEVEL _____ FT.		-CABLE LOSSES 3.6		-ESP = 19.6 USE 19	
XMTR. SITE HEIGHT ABOVE SEA LEVEL _____ FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL _____ FT.		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)		NO. OF SAMP	
TEST		TEST		TEST		TEST		TEST	
720310.11	71	71	71	720310.11	121	121.0	2		
71	71	71	71	121	121.0	121.0	2		
73	73	73	73	123	123.5	123.5	2		
73	73	73	73	123	123.0	123.0	2		
69	69	69	69	119	119.0	119.0	2		
67	67	67	67	117	117.0	117.0	2		
66	66	66	66	116	116.0	116.0	2		
65	65	65	65	115	115.0	115.0	2		
64	64	64	64	114	114.0	114.0	2		
63	63	63	63	113	113.0	113.0	2		
62	62	62	62	112	112.0	112.0	2		
59	59	59	59	109	109.0	109.0	1		
62	62	62	62	112	112				
63	63	63	63	113	113				
64	64	64	64	114	114				
65	65	65	65	115	115				
66	66	66	66	116	116				
67	67	67	67	117	117				
67	67	67	67	119	119				
73	73	73	73	123	123				

[illegible]

PROPAGATION PATH LOSS

DATE : 10 MARCH 72 TEST RUN S/N: 720310.12  
PATH: WAYSIDE SITE NO. 19B TO ECON/HEXAGON

OPER. FREQ. : 229.5 MHz



NOTE: T-29 ANT.  
HORIZ. POLARIZED

TEST DATA SHEET									
OPER. FREQ.		229.5 MHR		DATE: 10 MARCH 72		START: MRS.		FT.	
SITE		LOCATION		XMT. PWR.		TYPE ANTENNA		ANT. GAIN (dB)	
TRANSMITTER		WYYSIDE 19B		41 dBm		F-29 HARR		8.0	
RECEIVER		ECOM HEX.				AT-197		1.2	
TOTAL ANT. GAIN (XMT. + REC.)		8.0 + 1.2 = 9.2						dB	
TOTAL CABLE LOSS (XMT. + REC.)		1.8 + 1.8 = 3.6						dB	
XMT. SITE HEIGHT ABOVE SEA LEVEL		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		FT.			
XMT. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS		
	TEST	TEST	TEST	TEST					
720310.12									
8	75		720310.12		121.50	2			
10	71		121		120.0	2			
15	72		118		118.0	2			
20	70		116		116.5	2			
25	71		117		117.5	2			
30	74		120		120.0	2			
35	79		125		125.0	2			
40	74		120		120.5	2			
45	71		117		117.0	2			
50	70		116		116.5	2			
55	70		116		116.0	2			
60	70		116		116.0	1			
55	70		116						
50	71		117						
45	71		117						
40	74		121						
35	79		125						
30	74		120						
25	72		118						
20	71		117						

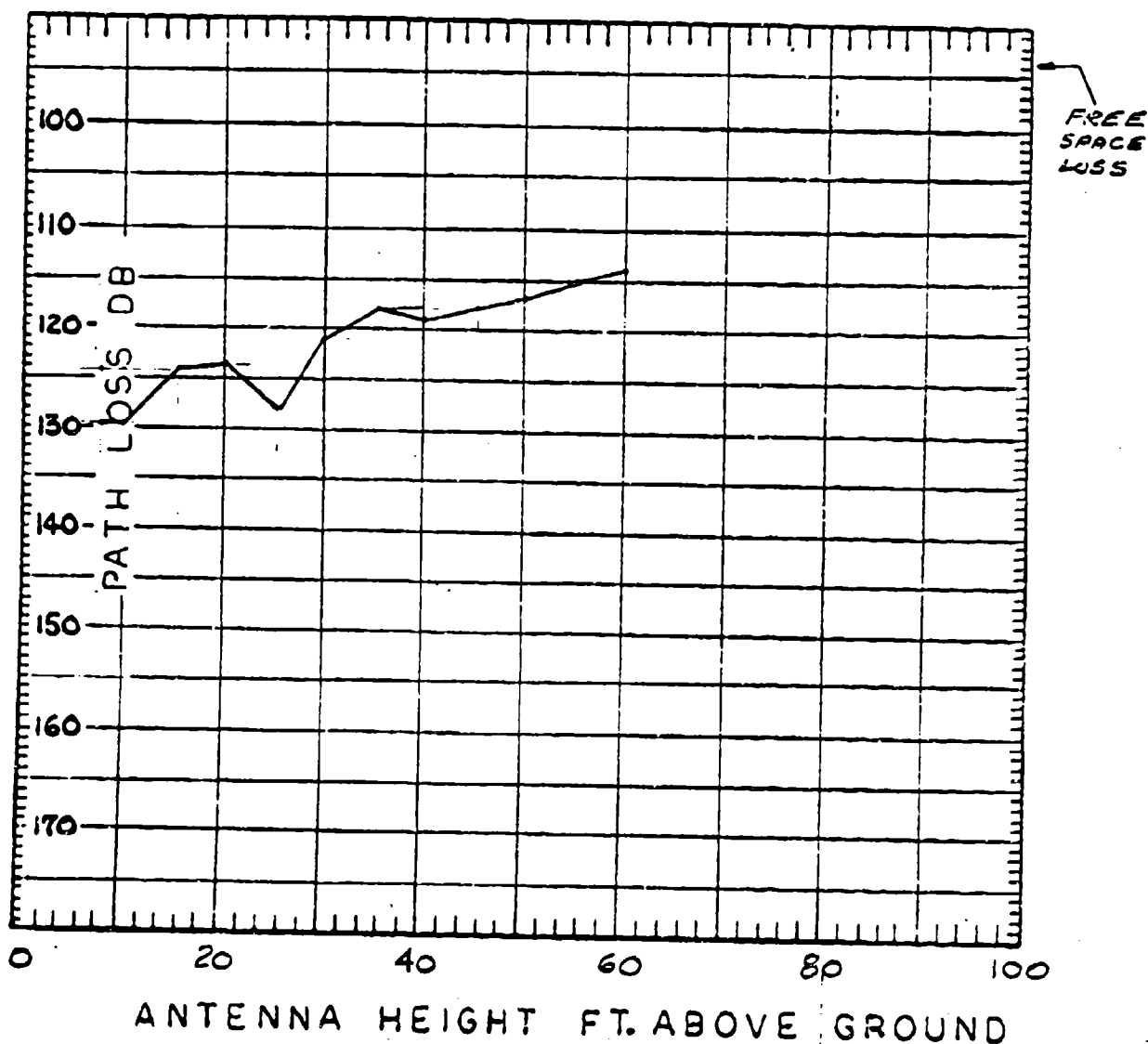
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# PROPAGATION PATH LOSS

DATE: 10 MARCH 72 TEST RUN S/N: 720310.13

PATH: WAYSIDE SITE NO. 19B TO ECOM HEXAG 711

OPER. FREQ.: 371.4 MHz



NOTE: T-29 ANT.  
HORIZ. POLARIZED



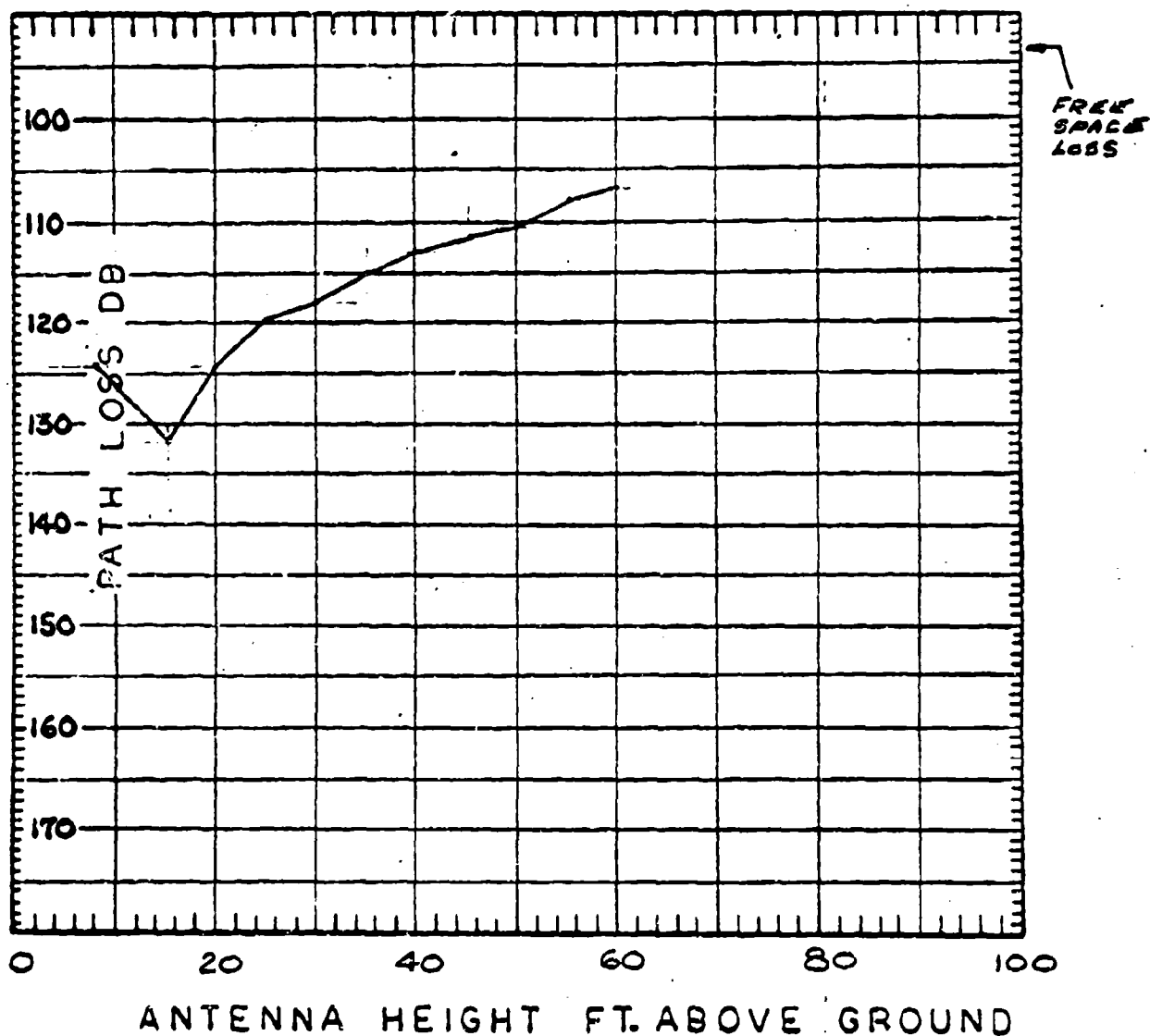
TEST DATA SHEET									
OPER. FREQ.		371.4 MHz		DATE: 10 MARCH 72		HRS.		MRS.	
SITE		LOCATION		REC. SITE ANT. HT.		FT.		START:	
TRANSMITTER		WIRYSIDE 19B	440RM	T-29 H6R12	8.0	CABLE LOSSES (dB)	2.3	EQUIV. SYS. PWR. (ESP)	44
RECEIVER		EOM HEX.		AT-197	2.0	CABLE LOSSES (dB)	2.3	XMT. PWR.	10
TOTAL ANT. GAIN (XMT + REC.)		8.0 + 2.0 = 10.0		dB				+ANT. GAINS	
TOTAL CABLE LOSS (XMT + REC.)		2.3 + 2.3 = 4.6		dB				-CABLE LOSSES	
XMT. SITE HEIGHT ABOVE SEA LEVEL		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		FT.		-ESP = -49.4 USE 49	
XMT. ANT. HT. ABOVE GND (FT)		RCVD. PWR. (dBm)		PATH LOSS (dB) - (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)		NO. OF SAMP	
TEST	TEST	TEST	TEST	TEST	TEST	TEST	TEST	TEST	TEST
7203 10.13				7203 10.13					
8	81			130			129.5	2	
10	91			130			129.5	2	
11	76			125			124.5	2	
20	75			124			124.0	2	
25	79			128			128.0	2	
30	72			121			121.0	2	
35	69			118			118.0	2	
40	70			119			119.0	2	
45	69			118			118.0	2	
50	68			117			117.0	2	
55	66			115			115.0	2	
60	65			114			114.0	1	
65	66			115					
70	68			117					
75	69			118					
80	70			119					
85	69			118					
90	72			121					
95	75			128					
100	74			124					



PROPAGATION PATH LOSS

DATE: 10 MARCH 72 TEST RUN SN: 720310.14  
PATH: WAYSIDE SITE No. 128 TO ECOM HEXAGON

OPER. FREQ.: 371.4 MHz



NOTE: T-29 ANT.  
VERT. POLARIZED

TEST DATA SHEET									
OPER. FREQ.		371.4 MHz		DATE: 10 MAR 11 72.		START:		HRS.	
SITE		LOCATION		REC. SITE ANT. HT.		FT.		EQUIV. SYS. PWR. (ESP)	
TRANSMITTER		W4 "SIDE 19B"		TYPE ANTENNA		ANT. GAIN (dB)		CABLE LOSSES (dB)	
RECEIVER		ECOM HEX.		XMT. PWR.		44 dBm		2.3	
TOTAL ANT. GAIN (XMT + REC.)		8.0 + 2.0 = 10.0		dB		2.0		2.3	
TOTAL CABLE LOSS (XMT + REC.)		2.3 + 2.3 = 4.6		dB		2.0		2.3	
XMT. SITE HEIGHT ABOVE SEA LEVEL		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		FT.		FT.	
XMT. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)	TEST	TEST	TEST	TEST	TEST	TEST	TEST	TEST
720310.14									
8	75								
10	77								
15	83								
20	75								
25	71								
30	69								
35	66								
40	64								
45	62								
50	61								
55	59								
60	58								
65	57								
70	62								
75	64								
80	66								
85	69								
90	71								
95	76								

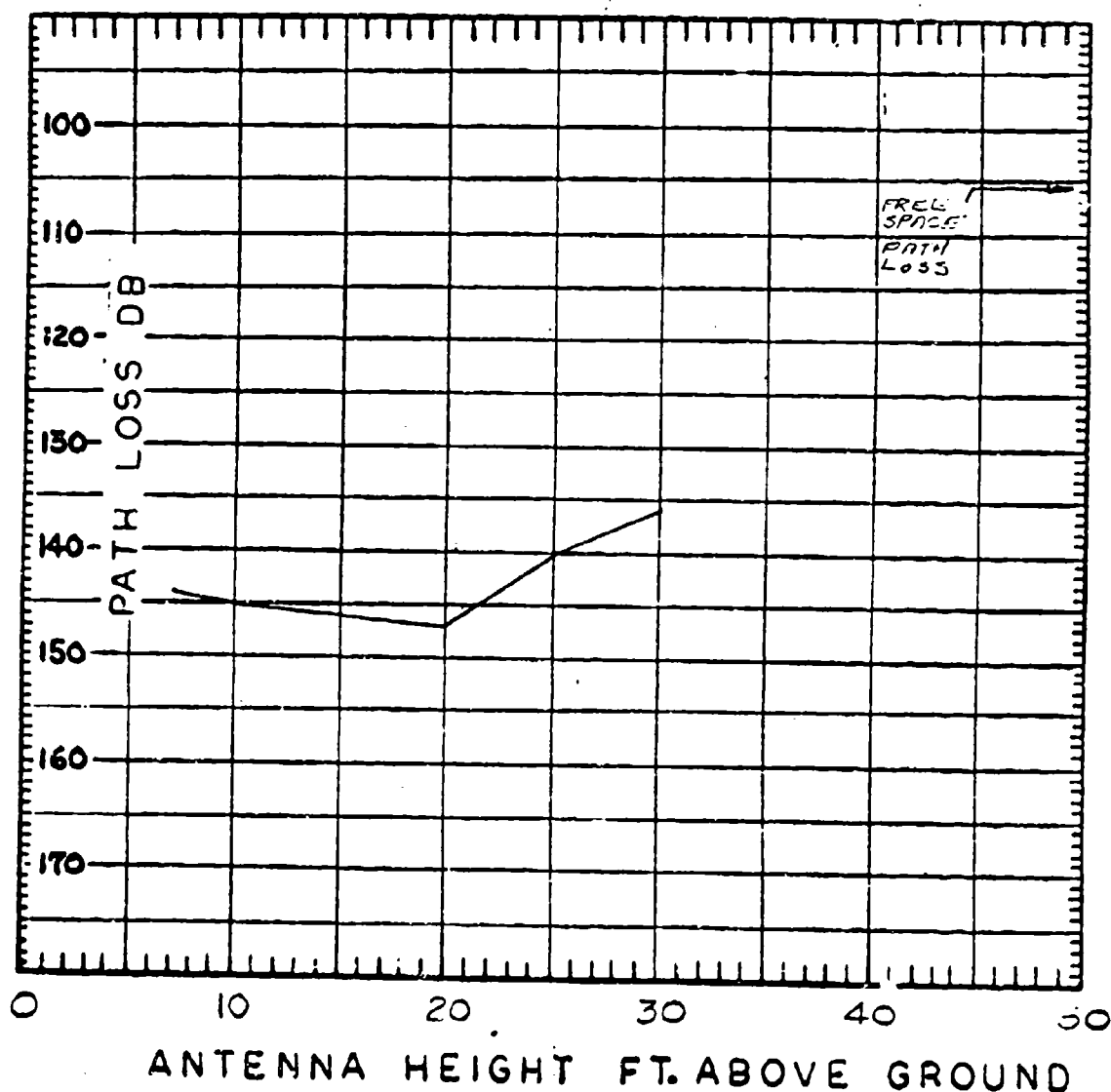
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# PROPAGATION PATH LOSS

DATE: 13 MARCH 72 TEST RUN S/N: 720313.01/02

PATH: NOYSELE SITE No. 19 TO ECCM HEX. 17311

OPER. FREQ.: 15.5 MHz



TEST DATA SHEET									
OPER. FREQ.	154.5 MHz		REC. SITE ANT. HT.		FT.		START:		HRS.
DATE: 13 MARCH 72									
SITE	LOCATION	XMTTR PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)			
TRANSMITTER	WAXSIDE 19	14 dBm	HEL. HORN	14.4	5.7	XMTTR. PWR. 44			
RECEIVER	ECOMPLEX		ANDREW BICONICAL	0.3	1.2	+ ANT. GAINS 14.7			
TOTAL ANT. GAIN (XMTTR + REC.)		14.4 + 0.3 = 14.7 dB							
TOTAL CABLE LOSS (XMTTR + REC.)		5.7 + 1.2 = 6.9 dB							
XMTTR. SITE HEIGHT ABOVE SEA LEVEL		140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140 FT.			
XMTTR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (1B) - (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS		
	TEST	TEST	TEST	TEST					
7	7203 15.01	7203 13.02	7203 13.01	7203 13.02	141.0	4			
10	90.3	92.3	142.3	144.3	145.0	4			
15	11.2	92.9	143.2	144.9	146.0	4			
20	97.0	99.8	149.0	141.8	147.0	4			
25	94.1	95.8	146.1	147.8	140.0	4			
30	88.1	89.4	140.8	141.4	136.0	2			
25	83.8	81.8	135.8	136.8					
20	88.3	89.5	135.3	141.5					
15	93.1	93.4	147.4	145.1					
10	95.0	94.4	147.0	146.4					
7	93.4	94.2	145.4	146.2					
	91.1	92.9	143.1	144.9					
<p>Pos. PEAK AVERAGE OF STRIP CHART RECORDINGS.</p>									

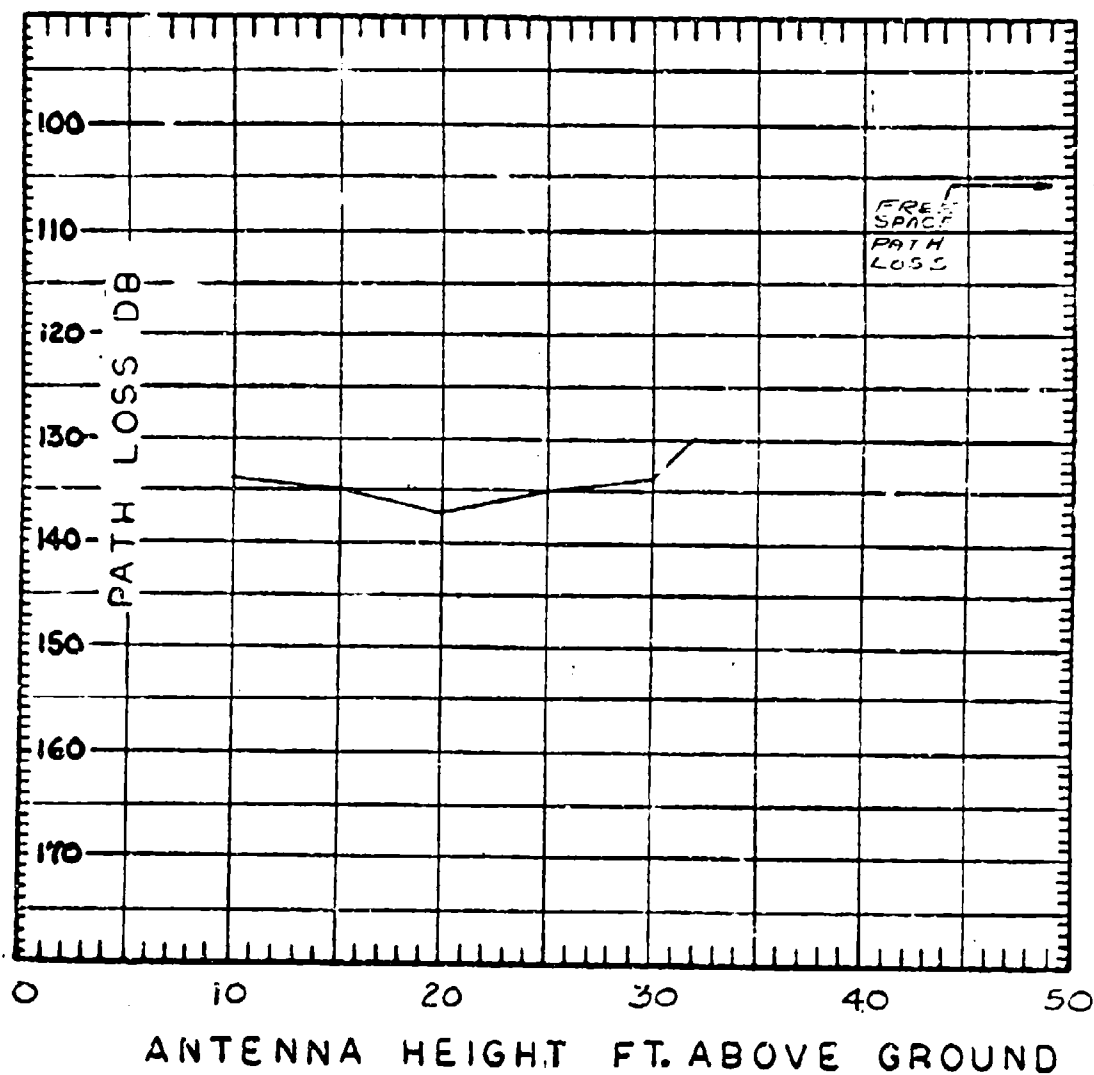
PAS. PEAK AVERAGE OF  
STRIP CHART RECORDINGS.

# PROPAGATION PATH LOSS

DATE: 13 MARCH 72 TEST RUN S/N: 720313.03:04

PATH: WAYSIDE SITE NO. 19 TO ECOM HEXAGON

OPER. FREQ.: 15.15 MHz



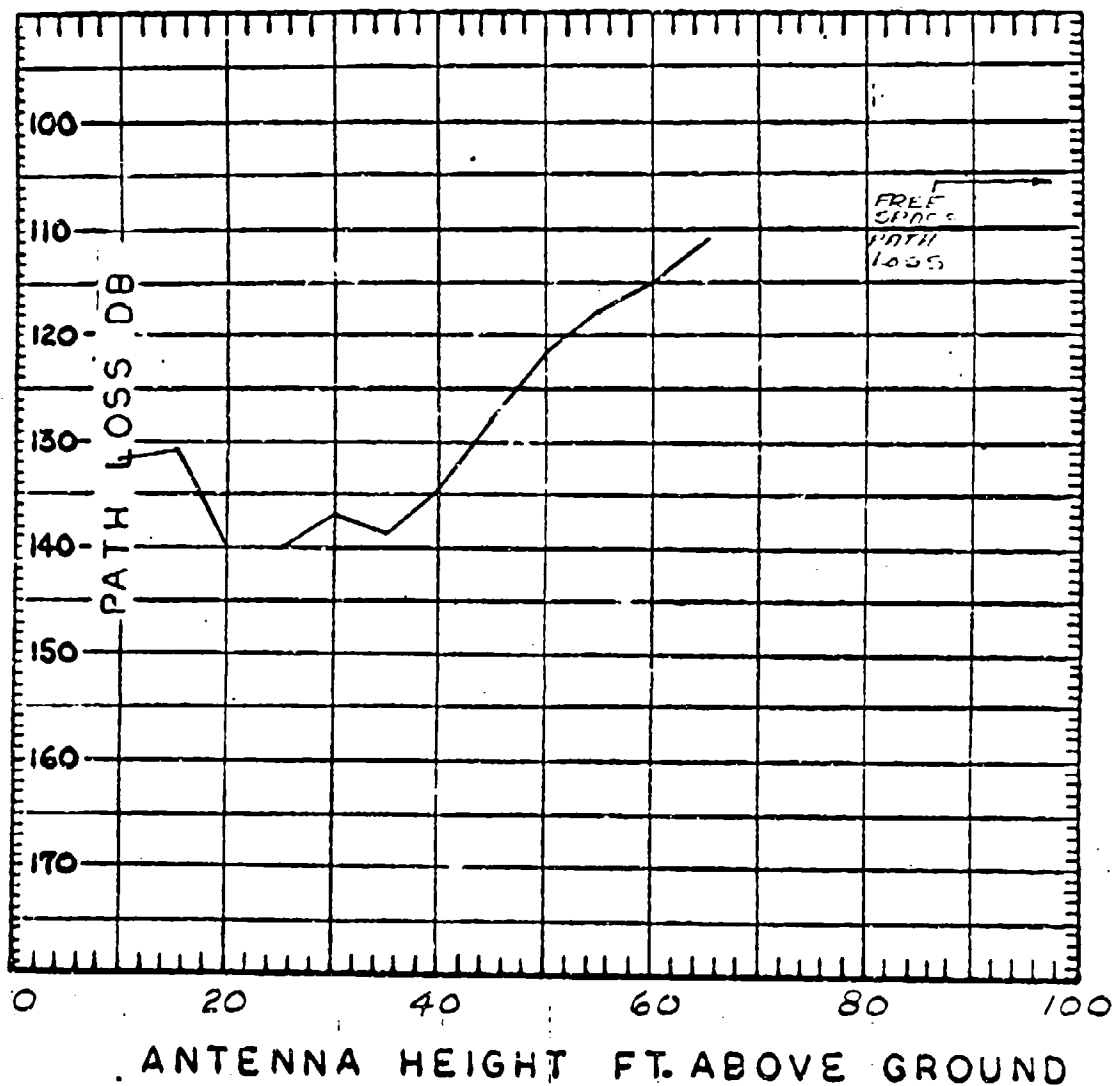




# PROPAGATION PATH LOSS

DATE: 13 MARCH 72 TEST RUN S/N: 720313.06197  
 PATH: WAYSIDE SITE NO. 19B TO ECOM HET/AG01

OPER. FREQ.: 154.5 MHz



TEST DATA SHEET									
OPER. FREQ. <u>1545 MHz</u>		DATE: <u>13 MARCH 72</u>		HRS. <u>START:</u>		FT. <u>START:</u>		HRS. <u>START:</u>	
SITE	LOCATION	XMIT. PWR. (dBm)	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)	XMIT. PWR. (dBm)	+ANT. GAINS	-CABLE LOSSES
TRANSMITTER	WAYSIDE 19B	44 dBm	HORN	14.4	5.7	44			
RECEIVER	ECON HEX		ANDREW BIGANICAL	0.3	1.2	14.7			
TOTAL ANT. GAIN (XMIT + REC.)		14.4 + 0.3 = 14.7		dB					
TOTAL CABLE LOSS (XMIT + REC.)		5.7 + 1.2 = 6.9		dB					
XMIT. SITE HEIGHT ABOVE SEA LEVEL		110		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140	
XMIT. ANT. HT. ABOVE GND (FT)		TEST		TEST		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	
7203, 13.06		7203, 13.07		7203, 13.06		7203, 13.07		NO. OF SAMPL	
10	90	93		142	142	132	4		
15	90	92		132	131	131	4		
20	86	90		138	139	140	4		
25	87	88		137	137	140	4		
30	87	90		136	139	137	4		
35	87	90		136	139	137	4		
40	87	85		135	134	135	4		
45	77	75		129	127	128	4		
50	67	74		121	123	122	4		
55	65	67		117	118	115	4		
60	62	65		114	114	115	4		
65	59	62		111	111	111	2		
70	64	65		116	114				
75	64	62		117	117				
80	72	72		124	121				
85	71	78		129	121				
90	86	86		137	135				
95	90	11		142	140				
100	86	87		134	136				
105	70	71		132	140				

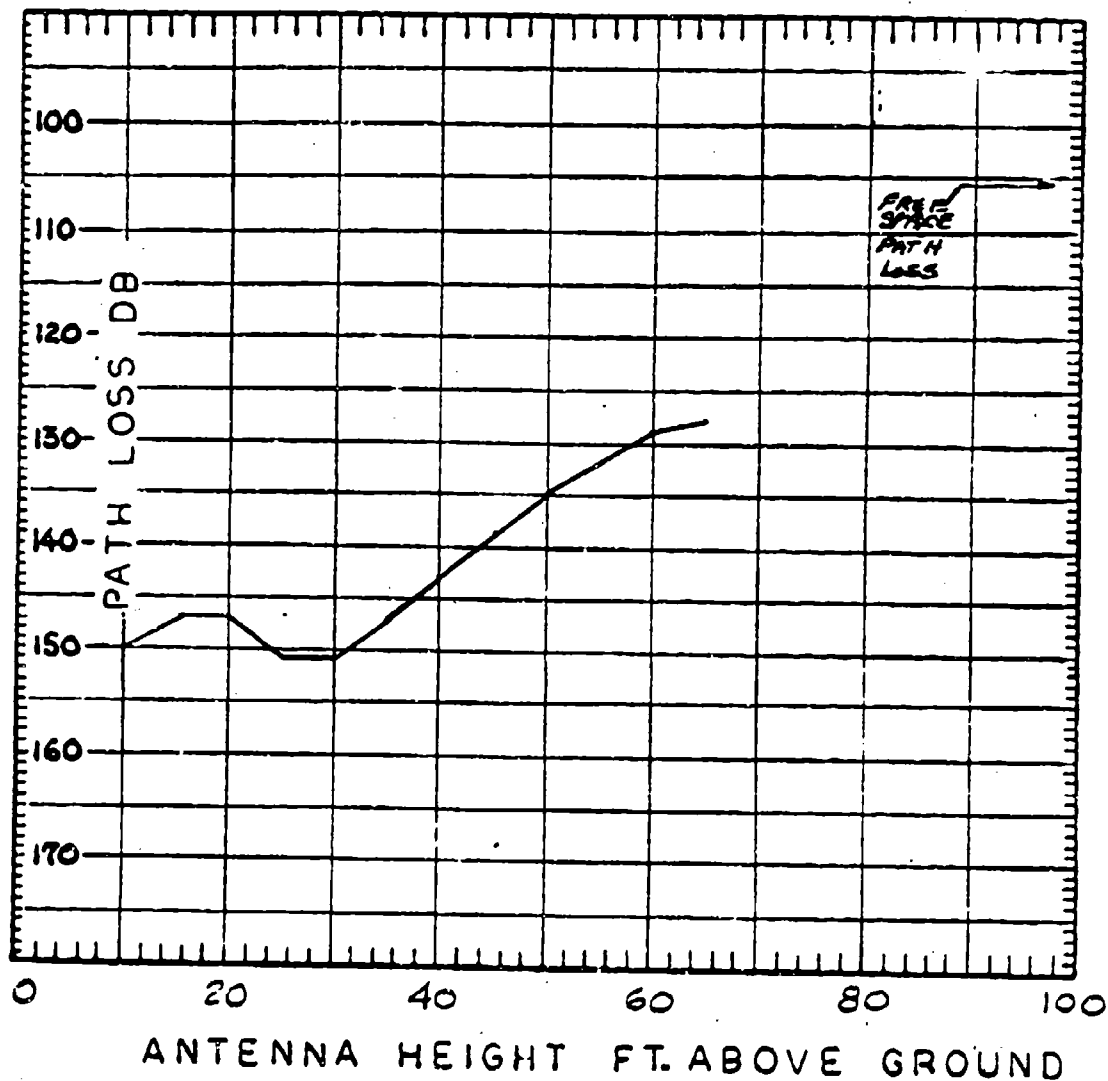
MEAN READING CHARTS



PROPAGATION PATH LOSS

DATE: 13 MARCH 72 TEST RUN SN: 720313.08409  
PATH: WAYSIDE SITE NO. 19B TO ECOM HEXAGON

OPER. FREQ.: 1545 MHz



TEST DATA SHEET									
OPER. FREQ.		1545 MHz		DATE: 13 MARCH 72		HRS.			
SITE		LOCATION		XMT. PWR.		TYPE ANTENNA		ANT. GAIN (dB)	
TRANSMITTER		WAYSIDE 198		415M		EMER 5108		-0.4	
RECEIVER		ECOMILEX.				BICONICAL		0.3	
TOTAL ANT. GAIN (XMT + REC.)				-0.4 + 0.3 =		-0.1 dB			
TOTAL CABLE LOSS (XMT + REC.)				5.7 + 1.2 =		6.9 dB			
XMT. SITE HEIGHT ABOVE SEA LEVEL		140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140 FT.			
XMT. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAHP	REMARKS		
	TEST	TEST	TEST	TEST					
10	7203/3.10			7203/3.10	141	2			
15	97			140	133	2			
20	96			130	130.5	2			
25	96			130	130.0	2			
30	98			132	131.0	2			
35	97			131	130.5	2			
40	95			129	128.0	2			
45	96			130	128.5	2			
50	87			121	121.5	2			
55	83			117	118.0	2			
60	81			115	116.0	2			
65	80			114	114.0	1			
70	83			117					
75	85			119					
80	88			122					
85	93			127					
90	93			127					
95	94			130					
100	94			130					
105	96			130					

TEST DATA SHEET									
OPER. FREQ. <u>1545 MHz</u>		DATE: <u>13 MARCH 72</u>		REC. SITE ANT. HT. <u>FT.</u>		START: <u>—</u>		MKS.	
SITE	LOCATION	XMITR. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)			
TRANSMITTER	WHISIDE 19B	41 dBm	HEL Horn	14.4	5.7	XMITR. PWR. 41			
RECEIVER	ECOM HEX.		ANDREW CONICAL	0.3	1.2	+ANT. GAINS 14.7			
TOTAL ANT. GAIN (XMITR + REC.)		14.4 + 0.3 =		14.7 dB		-CABLE LOSSES 6.9			
TOTAL CABLE LOSS (XMITR + REC.)		5.7 + 1.2 =		6.9 dB		-ESP = 48.8 USE 49			
XMITR. SITE HEIGHT ABOVE SEA LEVEL		140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140 FT.			
XMITR. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS		
	TEST	TEST	TEST	TEST					
10	70313.09	98	100	147	149	4	ANT HORIZ 1206.		
15		97	97	146	146	4			
20		95	98	144	147	4			
25		102	103	151	152	4			
30		97	105	146	154	4			
35		97	97	146	146	4			
40		94	95	143	144	4			
45		90	90	139	139	4			
50		86	86	135	135	4			
55		83	82	132	131	4			
60		80	80	129	129	4			
65		78	79	127	128	4			
60		78	80	127	129	2			
55		83	82	132	131				
50		87	83	136	132				
45		90	90	139	139				
40		95	93	144	142				
35		97	98	146	147				
30		100	106	149	155				
25		103	100	152	149				

MEAN READING OF STRIP CHART RECORDINGS

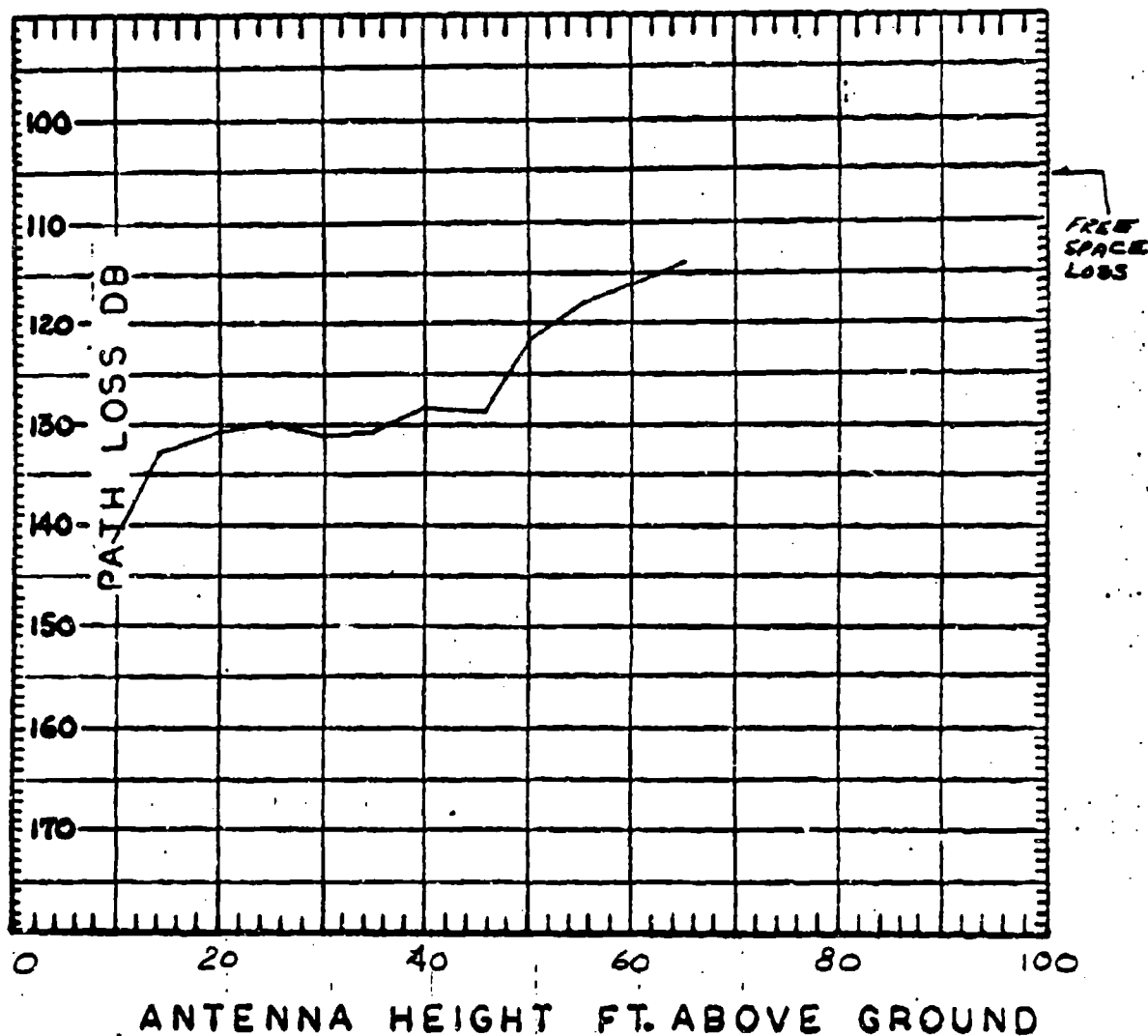
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# PROPAGATION PATH LOSS

DATE : 13 MARCH 72 TEST RUN SN: 720213.10  
PATH: WAYSIDE SITE No. 19B TO ECOM HEXAGON

OPER. FREQ. : 1545 MHZ



DATE: 13 MARCH 72

OPER. FREQ. 1545 MHz  
REL. SITE ANI. HT. \_\_\_\_\_ FT. \_\_\_\_\_  
START: \_\_\_\_\_

**START: \_\_\_\_\_ HRS.**

Fi.

REC. SITE ANT. HT.

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CITE	LOCATION	XHTR	TYPE ANTENNA	ANT. GAIN	CABLE	EQUIV. SYS. PWR. (ESP)
				7.48	1000000	

TRANSMITTER	W/HTY SIDE 198	41 dBm	LMCO 3102	-0.4	5.7	XNTR. PWR.	41
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RECEIVER	ECOM HEX	BICONICAL	+0.3	1.2	+ANT. GAINS -0.1
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TOTAL ANT. GAIN (XMITR + REC.)	-0.4 + 0.3 = -0.1 dB	-CABLE LOSSES	6.7
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TOTAL CAELE LOSS (XMTR + REC.)

YNTD	SITE	HEIGHT ABOVE SEA LEVEL	RCVR. ANT. HEIGHT ABOVE SEA LEVEL	FT.	FT.
140				140	140

XMTR.	RCVD. PWR. (dBm)	PATH LOSS (dB) =	AVG.

NO.	PATH.	(ESP) - (RCVD. PPK.)		REMARKS
		TEST	TEST	

BOVE	7203	LOSS	SAHP	DATE

10 (FT)	13.10	13.10	(dB)
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[illegible]

15.	101	135	1
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10	108	142			
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1. The first step in the process of identifying a problem is to define the problem. This involves identifying the symptoms of the problem and determining the scope of the problem. Once the problem has been defined, the next step is to identify the causes of the problem. This involves identifying the factors that are contributing to the problem and determining the underlying causes. Once the causes have been identified, the next step is to develop a plan to address the problem. This involves identifying the actions that need to be taken to address the problem and determining the resources that will be needed to implement the plan. Finally, the last step in the process is to implement the plan and monitor the results. This involves putting the plan into action and tracking the progress of the plan to ensure that the problem is being addressed effectively.

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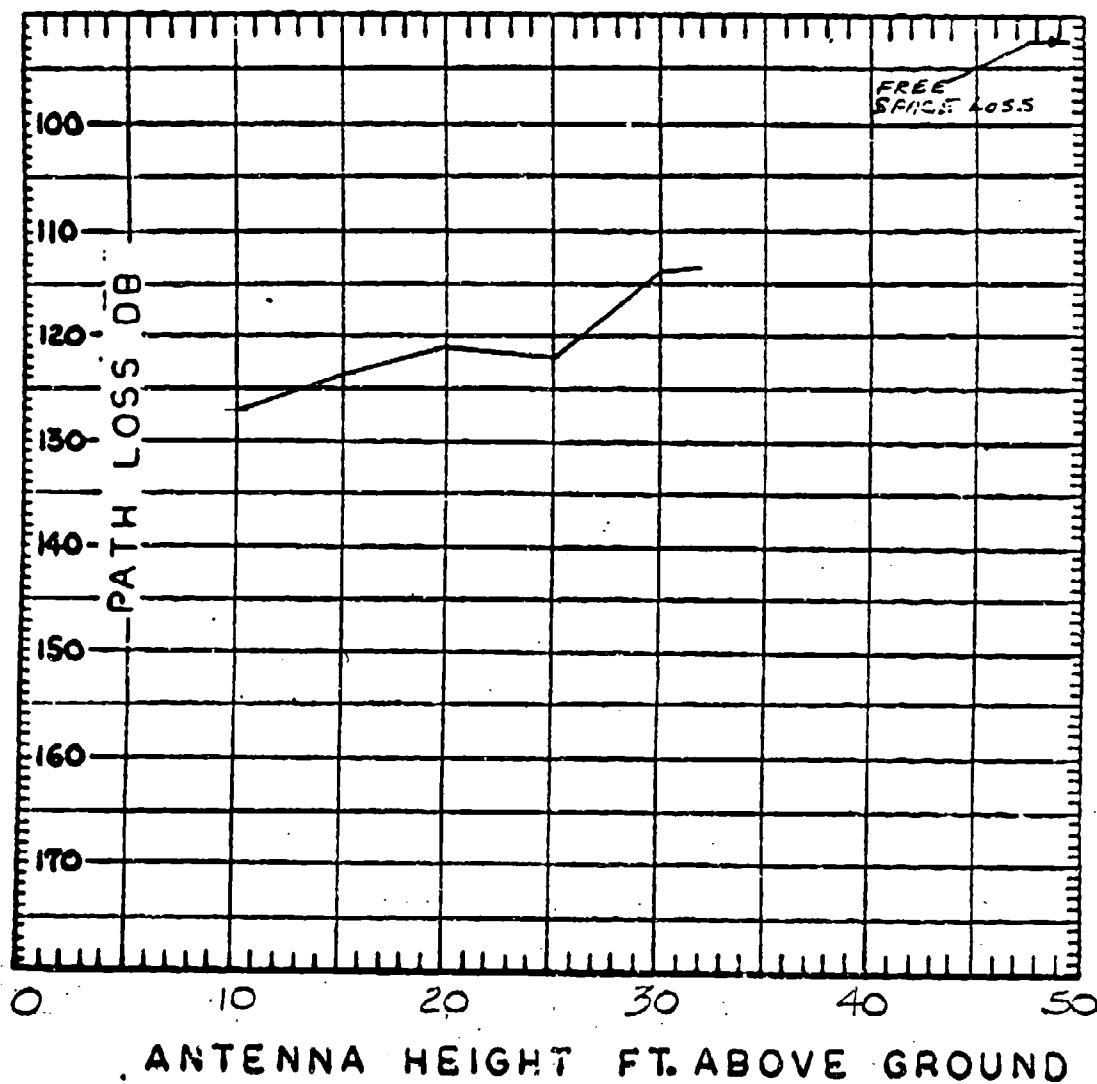
TEST DATA SHEET									
OPER. FREQ.		971.4 MHz		DATE: 14 MARCH 72		START: _____		HRS. _____	
SITE		LOCATION		REC. SITE ANT. HT. _____ FT.		ANT. GAIN (dB)		CABLE LOSSES (dB)	
TRANSMITTER		WAYSIDE 9		44dBm	AT-197	2.0	2.3	44	
RECEIVER		ECOM HEX.			AT-197	2.0	2.3	4	
TOTAL ANT. GAIN (XMT + REC.)		2.0 + 2.0 =		4.0 dB				4.6	
TOTAL CABLE LOSS (XMT + REC.)		2.3 + 2.3 =		4.6 dB				-ESP = 43.4 USE 43	
XMT. SITE HEIGHT ABOVE SEA LEVEL		140 FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		145		FT.	
XMT. ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP.	REMARKS		
	TEST	TEST	TEST	TEST					
10	7202 14.01	93	7203 14.01	7203 14.02	127	4			
15	84	79	127	136	124	4			
20	82	79	125	122	121	4			
25	80	80	123	123	122	4			
30	70	72	113	115	114	4			
32	70	71	113	114	113.5				
30	70	72	113	115					
25	79	78	122	121					
20	79	72	122	115					
15	78	82	121	125					
10	87	78	120	121					
							Pos. PEAK AVERAGING OF STRIP CHART RECORDINGS		

# PROPAGATION PATH LOSS

DATE: 14 MARCH 72 TEST RUN SN: 720314.01402

PATH: WAYSIDE SITE 9 TO ECOM HEXAGON

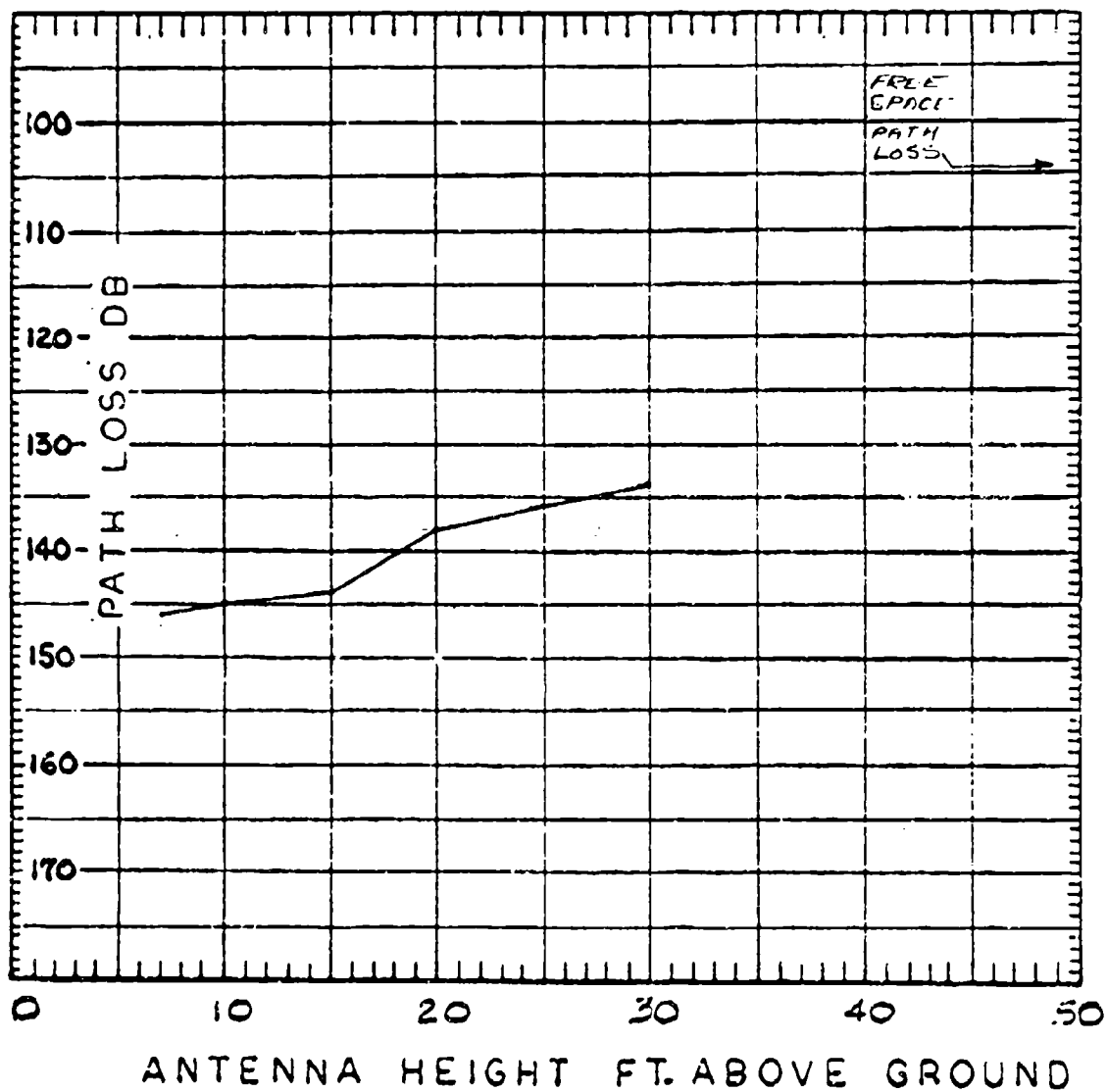
OPER. FREQ.: 371.4 MHz



TEST DATA SHEET									
OPER. FREQ. 1545 MHZ		DATE: 14 MARCH 72		REC. SITE ANT. HT. FT.		START: HRS.			
SITE	LOCATION	XMTR. PWR.	TYPE ANTENNA	ANT. GAIN (dB)	CABLE LOSSES (dB)	EQUIV. SYS. PWR. (ESP)	XMTR. PWR.	+ANT. GAINS	-CABLE LOSSES
TRANSMITTER	WAYSIDE 9	40 dBm	ANDREW DISCRETE	2.5	5.7	40			
RECEIVER	ECOM HX.		ANDREW BICONICAL	0.3	1.2	28			
TOTAL ANT. GAIN (XMTR + REC.)		2.5 + 0.3 = 2.8		dB					
TOTAL CABLE LOSS (XMTR + REC.)		5.7 + 1.2 = 6.9		dB					
XMTR. SITE HEIGHT ABOVE SEA LEVEL		140		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		140 FT.	
ANT. HT. ABOVE GND (FT)	RCVD. PWR. (dBm)		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		AVG. PATH. LOSS (dB)	NO. OF SAMP	REMARKS		
	TEST	TEST	TEST	TEST					
10	720314.05	720314.06	720314.05	720314.06					
15	106	105	142	141	141	4			
20	102	101	138	137	138	4			
25	102	102	138	138	138	4			
30	100	100	136	136	136	4			
32	98	97	134	133	134	4			
30	97	95	133	131	132	2			
25	98	97	134	133					
25	100	99	136	135					
20	101	102	137	138					
15	101	103	137	139					
10	103	104	139	140					
POSITIVE PEAK AVERAGING OF STRIP CHART RECORDINGS									

PROPAGATION PATH LOSS  
DATE: 14 MARCH 72 TEST RUN SN: 720314.07503  
PATH: WAYSIDE SITE NO. 9 TO ECOM HEXAGON

OPER. FREQ.: 154.5 MHz

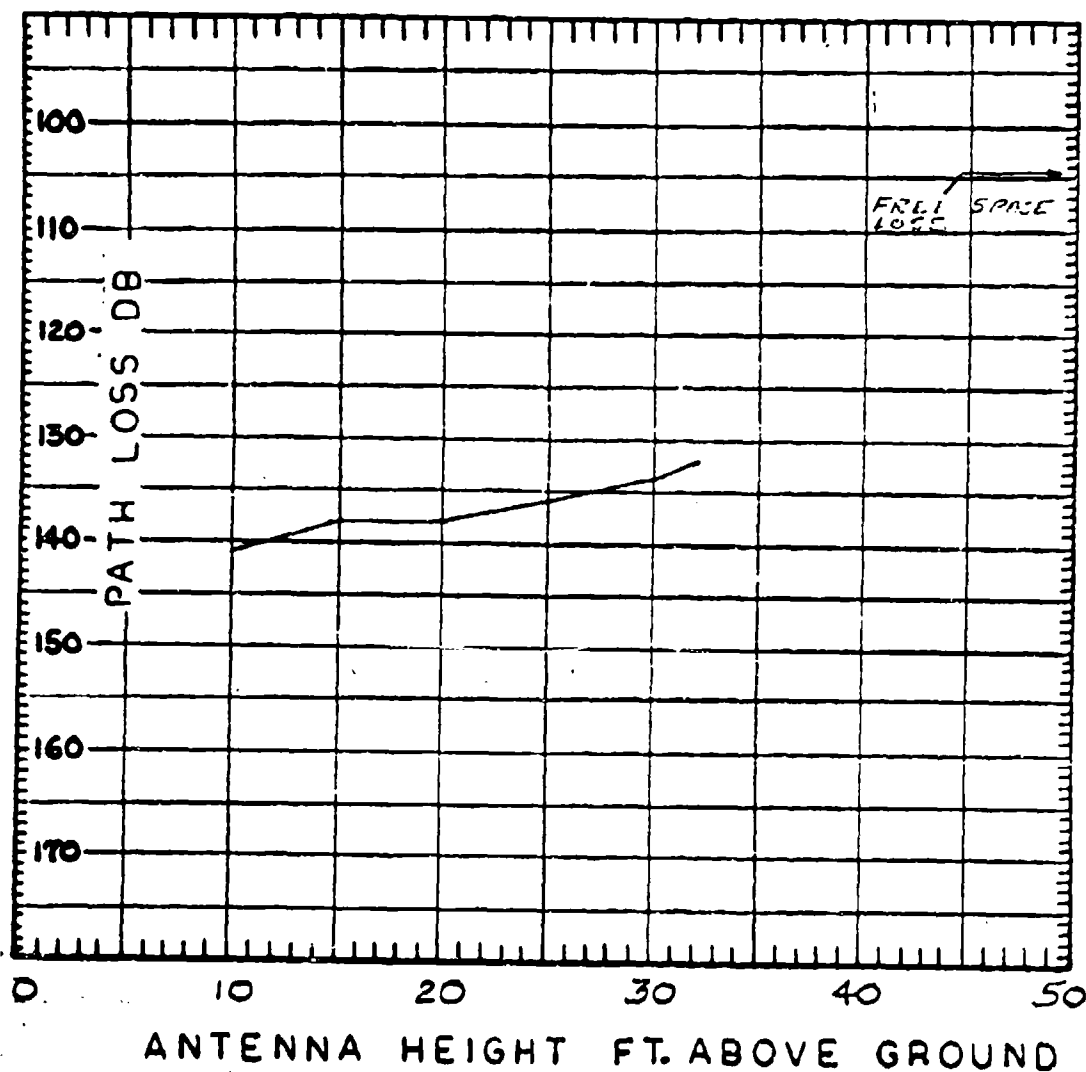


# PROPAGATION PATH LOSS

DATE: 14 MARCH 72 TEST RUN SN: 720314.05406

PATH: WAYSIDE SITE 9 TO ECCM HEXAGON

OPER. FREQ.: 15.45 MHz



TEST DATA SHEET									
OPER. FREQ.		229.5 MHz		DATE: 14 MARCH 72		HRS.		START:	
SITE		LOCATION		REC. SITE ANT. HT.		FT.		HRS.	
TRANSMITTER		WAXSIDE 9	44 dBm	TYPE ANTENNA	AT-197	ANT. GAIN (dB)	1.2	EQUIV. SYS. PWR. (ESP)	44
RECEIVER		ECOM HEX.		AT-197	1.2	ANT. GAINS	2.4	XMITR. PWR.	44
TOTAL ANT. GAIN (XMITR + REC.)		1.2 + 1.2 = 2.4		dB				-CABLE LOSSES	
TOTAL CABLE LOSS (XMITR + REC.)		1.8 + 1.8 = 3.6		dB				-ESP = 42.8 USE 4.3	
XMITR. SITE HEIGHT ABOVE SEA LEVEL		145		FT.		RCVR. ANT. HEIGHT ABOVE SEA LEVEL		145	
XMITR. ANT. HT. ABOVE GND (FT)		7203, 14.03		TEST		PATH LOSS (dB) = (ESP) - (RCVD. PWR.)		NO. OF SAMP	
10	75	73	7203, 14.04	7203, 14.03	118	116	117	4	
15	73	72	72	115	115	115	115	4	
20	72	72	72	115	115	115	115	4	
25	71	70	70	114	113	114	114	4	
30	70	70	70	113	113	113	113	4	
32	69	69	69	112	112	112	112	2	
30	69	69	69	112	112	112	112		
25	71	70	70	114	113	114			
20	71	73	73	114	114	114			
15	72	73	73	115	114	114			
10	73	75	75	118	114	114			
POSITIVE PEAK AVERAGING OF STRIP CHART RECORDINGS									

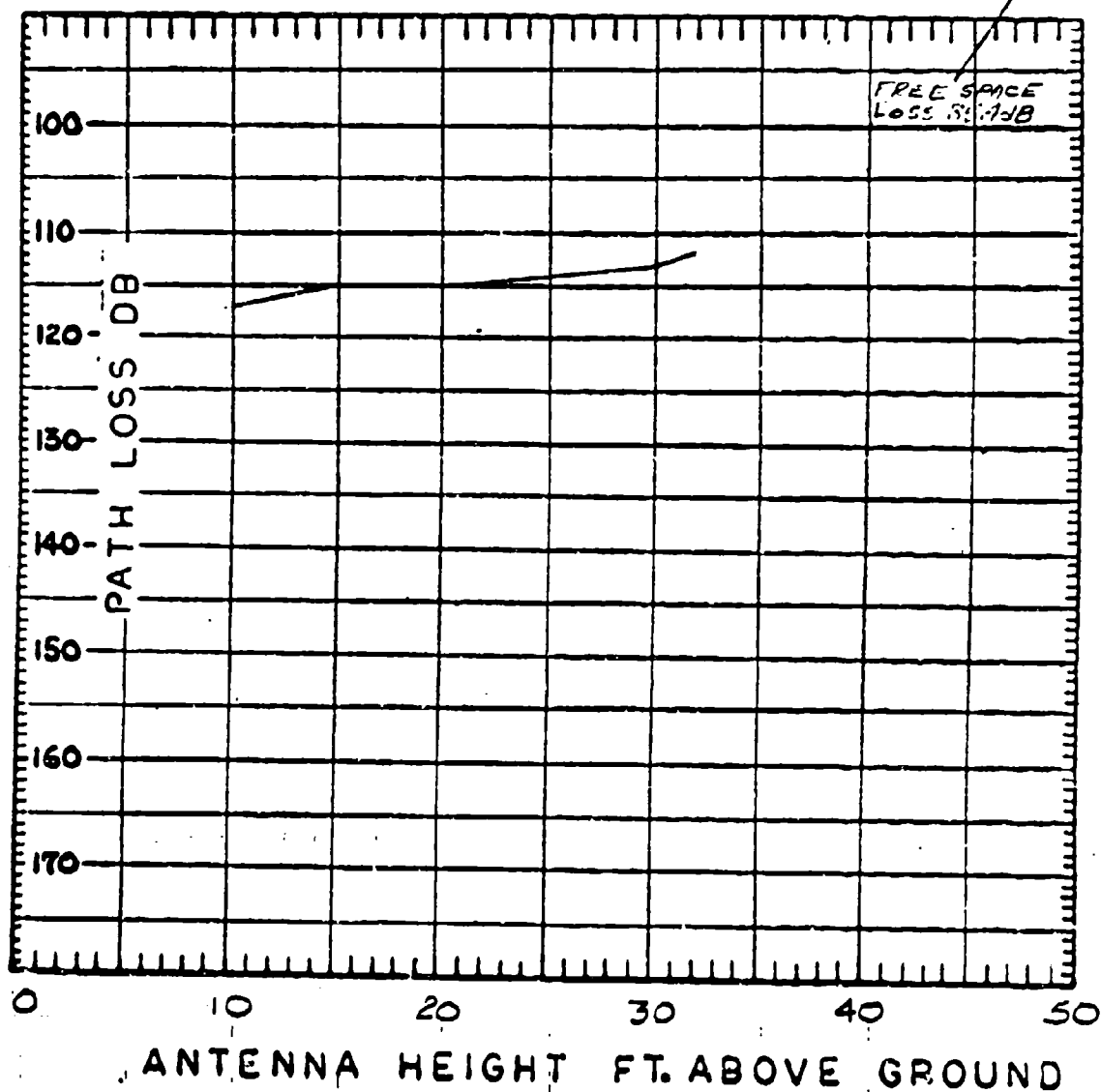


# PROPAGATION PATH LOSS

DATE: 14 MARCH 72 TEST RUN SN: 720314.0340.1

PATH: WAYSIDE SITE No. 9 TO ECOM HEXAGON

OPER. FREQ.: 229.5 MHz



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11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY US Army Electronics Command ATTN: AMSEL-VL-G Fort Monmouth, New Jersey 07703	
13. ABSTRACT This report covers RF path loss measurements near Fort Monmouth, N. J., over distances of up to 10 miles and at low grazing angles. Four frequencies were used during these tests, three in the UHF region and one just below it. Measurements were made with antennas vertically, horizontally, and circularly polarized. Paths were varied from non-line-of-sight to definitely line-of-sight. Comparison of losses under varying conditions were made and graphs for estimating losses in the area covered by these tests are included.			

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
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